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# Meat quality characteristics in Kıvırcık lambs

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**Abstract:** Eşme District in Uşak Province has a special role in western Anatolia sheep husbandry due to its number of animals and large pastures. A genotype with the characteristics of the Kıvırcık breed has emerged and became common in the region in the last 20–30 years. This study aimed to determine the meat quality characteristics of Kıvırcık lambs reared in the locality, which has a large market share. The study determined parameters about water and cooking loss and shear force in *M. longissimus dorsi*, *M. longissimus thoracis*, and *M. semitendinosus* muscles taken from the left half of lamb carcasses. Furthermore, meat quality characteristics such as pH, color, and fatty acid composition characteristics in the *M. longissimus dorsi* muscle were determined. In conclusion, the low shear force values (mean 2.27) obtained from Kıvırcık meat showed that it was tender. This result is consistent with the high demand from consumers for the meat of this breed.

**Key words:** Kıvırcık lamb, meat quality, fatty acid, lamb

## 1. Introduction

Sheep production has a significant share in the animal protein market and there are various factors affecting meat quality (1–3). Although lamb is considered fattier than other meats by a lot of consumers, its fat content is not regarded as a problem as it gives tenderness and more flavor to the meat. However, improper rearing and/or feeding conditions might cause excessive fattening, which reduces demand from customers. In recent years, the production of lamb, which is preferred by the majority of consumers in Turkey and Mediterranean countries, has declined in Turkey due to a numerical decrease in the sheep population.

In the western Anatolian region of Turkey (particularly in the Aegean and Marmara regions) there is a high demand for the meat of Kıvırcık and Kıvırcık crossbred lambs, which is one of the thin-tailed lamb genotypes. Eşme District in Uşak Province is a large market for lamb production in western Anatolia. Due to this demand, there is intensive lamb shipment from Eşme to many city and district centers in the Aegean Region, particularly to İzmir, for slaughter purposes between April and June. Apart from this period, large numbers are shipped to neighboring cities as sacrificial lambs.

Rearing systems and feeding conditions have a significant role in carcass formation and meat quality. Important factors in terms of carcass and meat quality include ratio of valuable carcass components, pH, color, water loss, cooking loss, tenderness, and fatty acid composition (4,5). Lamb meat quality involves parameters such as carcass quality characteristics (proportion and distribution of carcass components), meat quality characteristics (chemical composition, microbial characteristics), and eating quality evaluated by panelists (tenderness, juiciness, flavor, total acceptability). Although consumers and retailers desire high eating quality in meat, it is difficult to develop these characteristics due to the technological, financial, and biological limitations for animal farmers (6–8). Desirable traits in meat are high sensory characteristics such as tenderness, juiciness, color, flavor, and a high content of polyunsaturated fatty acids. Kıvırcık lamb is considered to have good meat quality compared to other breeds (6).

The present study aimed to determine meat quality of Kıvırcık lambs reared in Eşme, which has a large number of sheep. pH, color, tenderness, water loss, cooking loss, shear force properties, and fatty acid composition were determined from muscle samples collected from different sections of the carcass.

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## 2. Materials and methods

Animals in enterprises in Eşme District were hand-bred in the mating season and detailed birth records were kept including date of birth, sex of lambs, type of birth, ewe's live weight at birth, birth weight of lambs, and ear tags in birth period. Lambs that were used as study material were selected according to type of birth, live weight, and sex.

A total of 30 lambs (15 females and 15 males) underwent intensive feeding for a 10-week (70-day) period after weaning to determine meat quality characteristics. The animals, which were fed as a group, were given ad libitum fattening feed (HP 20.40%, ME 2728.30 kcal/kg) and 100 g of roughage per animal. At the end of the fattening period, the lambs were sent to a private slaughterhouse in Eşme for slaughter and dissection (mean slaughter live weight was 32.96 kg). The carcasses were kept in cold storage at +4 °C for 24 h and were then dissected. Mean cold carcass weight was 15.5 kg in the analyzed lambs.

Samples were taken from the *M. longissimus dorsi* (rib eye muscle), *M. semitendinosus*, and *M. longissimus thoracis* muscles in the left half of the carcass. Water and cooking loss and shear force values of the samples were determined. pH and fatty acid composition of *M. longissimus dorsi* muscle were identified. The *M. longissimus dorsi* muscle is the one that develops last in body development and there is a high correlation between the characteristics of this muscle and carcass sections. A pH-meter was used to measure pH values. Measurements were made during and 24 h after slaughtering. A colorimeter (Minolta CR-400) with a chromatic system was used for color measurements of samples. L*(brightness), a*(redness), and b*(yellowness) color parameters were determined.

Fatty acid composition of muscle samples was determined by gas chromatography based on the method reported by Tokuşoğlu (9). Fatty acids in the range of C10:0, C24:0, and conjugated linoleic acid (CLA) were identified in fatty acid composition and saturated fatty acids (SFAs), monounsaturated fatty acids (MUFAs), polyunsaturated fatty acids (PUFAs), and polyunsaturated fatty acids/saturated fatty acids ratio (P/S) values were calculated from the obtained values.

Methods reported by Honikel (10) were used to measure water holding capacity and cooking loss, while the method reported by Chrystall et al. (11) was used to analyze shear force. Cooking loss was calculated according to the lost weight at the end of the period on samples kept in a water bath for a certain time and at a certain temperature (70 °C, 90 min). Meat samples were cooked and cooled at room temperature. Samples 1 × 1 × 25 cm in size were cut from the carcasses parallel to the muscle fibers. A Zwick/Roell texture analysis test device (V-shaped knife of a Warner–Bratzler device) was used to make measurements for shear force values. The force applied by the knife on the meat was recorded in kilograms. Hardness of meat from different sexes or muscles was determined based on these results. Muscle types and characteristics of the analyzed meat samples are presented in Table 1.

GLM and CORR procedures in the SAS (12) statistics program were used for analysis of variance of the analyzed characteristics and to obtain least squares means and phenotypic correlation coefficients.

## 3. Results

### 3.1. pH and color

pH and color values of the *M. longissimus dorsi* muscle are summarized in Table 2.

Mean pH values of Kıvırcık meat during and 24 h after slaughtering were found to be 6.51 and 5.62, respectively. It was found that sex did not have a significant effect on these values. pH values measured in lambs were within normal meat pH values. This result showed that the animals were slaughtered under stress-free conditions, and that rigor mortis occurred accurately and that slaughtering procedures were compatible with the standards. It was found that sex had a significant effect on brightness color coordinates in Kıvırcık lambs reared in Eşme. It can be stated that male lambs had brighter meat than female lambs.

### 3.2. Water loss, cooking loss, and shear force

Shear force, cooking loss, and water loss results for different muscle types are presented in Table 3. Although muscle samples collected from female lambs had higher

**Table 1**. Muscle types and characteristics analyzed.

| | $pH_o$ | $pH_{24}$ | L* | a* | b* | WL | CL | SF | FAC |
|---|---|---|---|---|---|---|---|---|---|
| *M. Longissimus Dorsi* | X | X | X | X | X | X | X | X | X |
| *M. Longissimus Thoracis* | | | | | | X | X | X | |
| *M. Semitendinosus* | | | | | | X | X | X | |

X: indicates the analyzed properties, pHo: slaughter time, pH24: 24 h after slaughter, L*: lightness, a*: redness, b*: yellowness, WL: water loss (%), CL: cooking loss (%), SF: shear force (%), FAC: fatty acid composition (%).

**Table 2.** The mean and standard errors of least squares of pH versus color.

| Factors | N | L* | a* | b* | pHo | $pH_{24}$ |
|---|---|---|---|---|---|---|
| Sex | | * | | | | |
| Male | 14 | 42.21 ± 0.860 | 17.87 ± 0.372 | −1.16 ± 0.363 | 6.61 ± 0.101 | 5.67 ± 0.044 |
| Female | 15 | 39.62 ± 0.829 | 18.55 ± 0.358 | −1.41 ± 0.349 | 6.40 ± 0.097 | 5.57 ± 0.043 |
| Regression | | | | | | |
| Cold Car.We. | | −0.001 ± 0.255 | 0.086 ± 0.11 | 0.071 ± 0.108 | −0.01 ± 0.03 | −0.012 ± 0.013 |
| General | 29 | 40.91 ± 0.575 | 18.21 ± 0.249 | −1.29 ± 0.243 | 6.51 ± 0.068 | 5.62 ± 0.03 |

* P < 0.05, ** P < 0.01, *** P < 0.001.
Cold Car.We: cold carcass weight, L*: lightness index, a*: redness index; b*: yellowness index.

**Table 3.** The mean and standard errors of least squares of shear force, cooking loss, and water loss according to muscle types.

| | N | Shear force kg/cm$^2$ | Cooking loss (%) | Water loss (%) |
|---|---|---|---|---|
| Muscle type | | *** | *** | *** |
| LD | 29 | 1.69 ± 0.155 | 26.80 ± 0.768 | 7.13 ± 0.296 |
| LT | 29 | 2.09 ± 0.155 | 28.76 ± 0.768 | 5.58 ± 0.296 |
| MS | 29 | 3.03 ± 0.155 | 24.10 ± 0.768 | 4.87 ± 0.296 |
| Sex | | | * | |
| Male | 42 | 2.09 ± 0.134 | 25.54 ± 0.663 | 5.56 ± 0.256 |
| Female | 45 | 2.44 ± 0.129 | 27.57 ± 0.639 | 6.15 ± 0.246 |
| Linear regression | | | | ** |
| Cold carcass weight | | 0.016 ± 0.04 | 0.222 ± 0.197 | 0.226 ± 0.076 |
| General | 87 | 2.27 ± 0.090 | 26.55 ± 0.443 | 5.86 ± 0.171 |

LD: *longissimus dorsi*, LT: *longissimus thoracis*, MS: *musculus semitendinosus.*
* P < 0.05, ** P < 0.01, *** P < 0.001.

shear force than those from male lambs, there was no statistically significant difference between the sexes. The highest shear force value was obtained from the *M. semitendinosus* muscle. This indicates that this muscle is the hardest meat, while the *M. longissimus dorsi* muscle had the tenderest meat (P < 0.001).

It was observed that the *M. semitendinosus* muscle had significantly lower cooking loss than other muscle sections (P < 0.001). Ewes had higher cooking loss than rams (P < 0.05). Breed, chemical composition of meat, muscle type, surface area, sex, and cooking temperature and time affected cooking loss. Although different cooking methods and muscle sections showed varying values in various studies, cooking loss (mean 26.55%) in the present study was within normal values.

It was found that water loss in rib-eye muscle was higher than that in other muscles (P < 0.001). Analysis of water loss in terms of sex showed that, unlike other characteristics, ewes generally had higher water loss. Kıvırcık lambs reared in Eşme showed high levels of water loss. Water loss is affected by various factors such as genetic factors, variation in pH, rigor mortis, storage temperature and time, and amount of meat. These factors also determine how to process and consume meat.

Correlations between the measurements in the *M. longissimus dorsi* muscle are presented in Table 4. There

**Table 4.** The correlation of *M. longissimus dorsi* muscle properties.

| | CCW | SF | CL | WL | pH24 | L* | a* |
|---|---|---|---|---|---|---|---|
| KK | $-0.11^{NS}$ | | | | | | |
| PK | $-0.10^{NS}$ | $0.29^{NS}$ | | | | | |
| SK | $0.20^{NS}$ | $-0.14^{NS}$ | $0.37^{*}$ | | | | |
| pH24 | $-0.06^{NS}$ | $-0.03^{NS}$ | $0.05^{NS}$ | $-0.18^{NS}$ | | | |
| L* | $0.15^{NS}$ | $-0.24^{NS}$ | $-0.22^{NS}$ | $-0.08^{NS}$ | $-0.08^{NS}$ | | |
| a* | $0.06^{NS}$ | $-0.01^{NS}$ | $-0.30^{NS}$ | $-0.19^{NS}$ | $-0.21^{NS}$ | $-0.04^{NS}$ | |
| b* | $0.17^{NS}$ | $-0.30^{NS}$ | $-0.33^{NS}$ | $-0.13^{NS}$ | $-0.26^{NS}$ | $0.17^{NS}$ | $0.66^{***}$ |

CCW: cold carcass weight, SF: shear force, CL: cooking loss, WL: water loss.
* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

was a significant correlation between water loss and cooking loss ($P < 0.05$). There were significant and positive correlations between a* and b* color values ($P < 0.001$). Other correlations were not statistically significant. There was no significant correlation in terms of characteristics between *M. longissimus thoracis* and *M. semitendinosus* muscles.

### 3.3. Fatty acid composition

Data on fatty acid composition are presented in Table 5. There was a difference in tC18:1 (trans oleic acid) and C18:2 (linoleic acid) fatty acids in terms of sex ($P < 0.01$). PUFA and P/S values were statistically significant ($P < 0.01$). This can be explained by higher PUFA levels in rams. The MUFA ratio was found to be generally higher, while the PUFA ratio and CLA values were lower in Kıvırcık lambs.

## 4. Discussion

### 4.1. pH and color

Much of the previous research has reported that there were differences between carcass and meat quality with feeding mixed forage and pasture (4–6,12).

Fresh-cut animal meat (pH 7.0–7.5) is nondurable, has low aroma and flavor, is difficult to chew, and has a sticky structure. pH value decreases slightly with slaughter. The value pH will reach in 24 h has a significant effect on the organoleptic (color, juiciness, flavor) and technologic/processing (water retention capacity and shelf life) characteristics of meat. If an animal is slaughtered under stress-free conditions and there is a sufficient amount of glycogen in muscles, the pH of meat decreases to the desired level (pH 5.4–5.7) 24 h after slaughtering (5,13,14).

Meat color varies according to oxymyoglobin to metmyoglobin formation, which is a result of the chemical reactions of myoglobin due to meat pH and oxidation. pH affects enzyme activity in meat; higher pH values give a darker color to meat. It is difficult to make an evaluation based on color values, since meat color is affected by many genetic and environmental factors. Significant correlations between these characteristics and study methods and conditions directly affect study results (4,13). When compared to similar studies, there was no significant difference between pH, L* (brightness), and a* (redness) values; however, the b* (yellowness) value was found to be much lower than in previous studies (6,15,16).

### 4.2. Water loss, cooking loss, and shear force

Like many other nutrients, meat has a high content of water in its composition. Water content varies between 70% and 80%, according to structure and type of muscle. Water in meat is desirable for economic and technological purposes. In addition, the removal of water from tissue has negative effects on some sensory characteristics of meat. Water lost due to cooking causes meat to shrink and causes deformation. In addition, water loss weakens characteristics such as tenderness and juiciness (10,17).

Cooking loss values of the meat of Kıvırcık lambs reared in Eşme were found to be in parallel to the study by Ekiz et al. (6), though they were found to be lower than those reported by Çelik et al. (18) and Abdullah et al. (19). In addition, water loss values obtained in this study were found to be higher than those in many other studies (6,18). Although shear force values were in parallel to those of previous studies, it can be stated that they were lower (18,19). Cooking methods and different muscle type significantly affect the shear force of meat. Shear force value defines the hardness of meat. A shear force value higher than 9 $kg/cm^2$ decreases the acceptability of meat. In the present study, the shear force of Kıvırcık lambs was found to be normal (mean 2.27) and the meat can be considered tender.

**Table 5.** The mean and standard errors of least squares of fatty acids composition.

| | Sex | | | Linear Reg. | General (N = 29) |
|---|---|---|---|---|---|
| | Male (N = 14) | Female (N = 15) | Sign. | Cold carcass weight | |
| Capric acid (C10:0) (%) | 0.10 ± 0.006 | 0.11 ± 0.006 | NS | 0.000 ± 0.002$^{NS}$ | 0.11 ± 0.004 |
| Lauric acid (C12:0) (%) | 0.07 ± 0.009 | 0.09 ± 0.009 | NS | 0.002 ± 0.003$^{NS}$ | 0.08 ± 0.006 |
| Miristic acid (C14:0) (%) | 1.77 ± 0.118 | 2.00 ± 0.113 | NS | 0.028 ± 0.035$^{NS}$ | 1.89 ± 0.079 |
| Pantadecanoic acid (C15:0) (%) | 0.29 ± 0.018 | 0.27 ± 0.017 | NS | –0.003 ± 0.005$^{NS}$ | 0.28 ± 0.012 |
| Palmitic acid (C16:0) (%) | 22.89 ± 0.765 | 23.33 ± 0.737 | NS | 0.271 ± 0.227$^{NS}$ | 23.11 ± 0.511 |
| Palmitoleic acid (C16:1) (%) | 2.46 ± 0.115 | 2.44 ± 0.111 | NS | 0.027 ± 0.034$^{NS}$ | 2.45 ± 0.077 |
| Heptadecanoic acid (C17:0) (%) | 1.14 ± 0.061 | 1.12 ± 0.059 | NS | –0.025 ± 0.018$^{NS}$ | 1.13 ± 0.041 |
| Cis10 heptadecanoic acid (C17:1) (%) | 0.70 ± 0.048 | 0.69 ± 0.046 | NS | –0.003 ± 0.014$^{NS}$ | 0.70 ± 0.032 |
| Stearic acid (C18:0) (%) | 14.17 ± 1.017 | 14.74 ± 0.980 | NS | –0.357 ± 0.302$^{NS}$ | 14.45 ± 0.68 |
| Trans elaidic acid (tC18:1) (%) | 5.97 ± 0.475 | 3.71 ± 0.457 | ** | –0.060 ± 0.141$^{NS}$ | 4.84 ± 0.317 |
| Oleic acid (C18:1) (%) | 45.14 ± 1.048 | 47.48 ± 1.010 | NS | 0.243 ± 0.311$^{NS}$ | 46.31 ± 0.701 |
| Conjugated linoleic acid (CLA) (%) | 0.15 ± 0.010 | 0.17 ± 0.010 | NS | 0.003 ± 0.003$^{NS}$ | 0.16 ± 0.007 |
| Linoleic acid (C18:2) (%) | 4.07 ± 0.238 | 2.86 ± 0.230 | ** | –0.090 ± 0.071$^{NS}$ | 3.46 ± 0.159 |
| Translinolenic acid (tC18:3) (%) | 0.01 ± 0.006 | 0.01 ± 0.005 | NS | 0.002 ± 0.002$^{NS}$ | 0.01 ± 0.004 |
| Linolenic acid (C18:3) (%) | 0.34 ± 0.030 | 0.29 ± 0.029 | NS | –0.006 ± 0.009$^{NS}$ | 0.32 ± 0.020 |
| Arachidic acid (C20:0) (%) | 0.10 ± 0.020 | 0.06 ± 0.019 | NS | –0.014 ± 0.006* | 0.08 ± 0.013 |
| Eicosenoic acid (C20:1) (%) | 0.28 ± 0.034 | 0.26 ± 0.033 | NS | 0.016 ± 0.010$^{NS}$ | 0.27 ± 0.023 |
| Behenic acid (C22:0) (%) | 0.15 ± 0.023 | 0.12 ± 0.022 | NS | –0.007 ± 0.007$^{NS}$ | 0.14 ± 0.015 |
| Erusic acid (C22:1) (%) | 0.02 ± 0.011 | 0.02 ± 0.011 | NS | 0.004 ± 0.003$^{NS}$ | 0.02 ± 0.008 |
| Lignoseric acid (C24:0) (%) | 0.18 ± 0.046 | 0.23 ± 0.044 | NS | –0.031 ± 0.014* | 0.21 ± 0.031 |
| Saturated fatty acids (SFA) | 40.87 ± 0.831 | 42.08 ± 0.801 | NS | –0.136 ± 0.247$^{NS}$ | 41.47 ± 0.556 |
| Monounsaturated fatty acids (MUFA) | 54.56 ± 0.860 | 54.60 ± 0.828 | NS | 0.227 ± 0.255$^{NS}$ | 54.58 ± 0.575 |
| Polyunsaturated fatty acids (PUFA) | 4.57 ± 0.265 | 3.33 ± 0.255 | ** | –0.092 ± 0.079$^{NS}$ | 3.95 ± 0.177 |
| P/S (PUFA/SFA) | 0.11 ± 0.007 | 0.08 ± 0.006 | ** | –0.002 ± 0.002$^{NS}$ | 0.10 ± 0.004 |

* $P < 0.05$, ** $P < 0.01$, NS: nonsignificant.

**4.3. Fatty acid composition**

Fatty acid composition has a significant role to determine meat quality and is generally related to meat aroma and nutritional value. SFAs are significant risk factors in the human diet, particularly in coronary heart disease. In this context, many studies concentrate on P/S and n-6/n-3 PUFA ratios (20). Recent studies have generally focused on the effects of fatty acids on lipid metabolism, coronary heart disease, and CLA levels in meat of ruminants. Lamb produced in Europe generally shows characteristic differences from the meat produced in other countries. Lambs are slaughtered at an early age, after feeding under intensive conditions or in pasturage generally immediately after or a short time after weaning (21,22). In terms of fatty acid composition, although values identified in Kıvırcık lambs (Table 4) were similar to those in the literature, there were certain differences (23–26). These differences (P/S, n-6-n-3 PUFA, CLA) are affected by many factors (breed, sex, feeding system), but these differences are normal.

As a result, P/S was found to be lower. This can be explained by intensive feeding of animals. In grazed animals, PUFA and CLA values generally increase; SFA values generally decrease depending on the condition of the pasturage, which has a positive impact on the health of meat.

In addition, if we set aside the price factor, fat ratio and nutritional content are highly influential in consumers' meat preference. Previous research reported that nutritional content and fat level of lamb did not significantly vary from other types of meat (cattle, goat). Furthermore, it was scientifically proven that, regarding cardiovascular conditions, characteristics such as fatty acid composition and CLA in lamb were at positive levels (13).

There are more than 100 types of fatty acids in lamb fat tissue. In fat composition, palmitic acid (C16:0), stearic acid (C18:0), and oleic acid (C18:1 n-9) are prominent. Samples used in many studies have shown that C16:0 and C18:1 fatty acids are the 2 fatty acids important in terms of weight, and that both of them show few variations in total. Fat in the pelvic and abdominal regions in lamb carcasses showed significantly higher ratios of SFAs than intramuscular and back fat thickness, which directly affects meat quality. On the other hand, live weight increase affects fatty acid content in lamb fat tissue in 2 ways. The first one is that live weight increase is related to weaning time; if this period is lengthened, C14:0, C16:0, and C16:1 fatty acids decrease, while C18:0 content increases. The second one is the increase in fatty acids containing odd numbers of carbon due to the increased activity of rumen microorganisms. Fat tissues of lambs with low body weight generally do not contain fatty acids containing odd numbers of carbon and branched fatty acids, since they have short weaning times. On the other hand, in older animals, the C16:1/C16:0 ratio is high in terms of multiple unsaturated fatty acids and this indicates increased fattening (27).

Although C16:0, C18:0, and C18:1 fatty acids and P/S ratio values in Kıvrıcık lambs were parallel to those in the study on Kıvrıcık and Sakız lambs, C18:1 levels were high and the P/S was low (23). Based on the same fatty acids according to the study by Vacca et al. (28), the C16:0 value was similar; however, C18:0 and C18:1 fatty acids were significantly higher. It was found that the SFA ratio was similar, the MUFA ratio was increased, and the PUFA ratio was decreased. When compared to a previous study carried out to determine fatty acid composition in commercially available lamb and cattle meat, SFA values were similar, MUFA values were higher, and PUFA and the P/S ratios were lower (26).

When compared to a study carried out to determine fatty acid composition in lambs in different rearing systems in Spain, Germany, England, and Uruguay, linoleic acid and CLA levels in Eşme lambs were found to be lower, while the P/S ratios were similar (29).

In conclusion, this study indicates that the Eşme Kıvırcık genotype generally shows typical lamb meat characteristics. At the end of the 70-day feeding, Eşme Kıvrıcık lambs had a mean live slaughter weight of 32.96 kg and a cold carcass weight of 15.15 kg. In our study, it was observed that the b* (yellowness) value in the present study was much lower than literature data.

Tenderness is affected by various factors such as breed, sex, slaughter procedures, maturing stages of meat, muscle type collected from various sections of the carcass, meat muscle fiber type, collagen content, cooking temperature, and cooking time. This makes identification of tenderness measurements difficult. However, it is possible to measure the force applied to the meat using relevant devices. It can be stated that meat of Kıvırcık lambs is highly tender in terms of shear force. Pressure per approximately 1 $cm^2$ area of meat was measured as mean 2 kg, which is much lower than that of many other breeds. This result also supports the high demand for Kıvırcık meat.

As for fatty acid composition, it was clear that PUFA and CLA values decreased in animals. In addition, among MUFAs, C18:1 values were found to be high. Low PUFA values caused lower P/S values. This can be explained by the fact the animals were fed in intensive systems without grazing. Comparative evaluation of sensory tests of the obtained meat with other breeds in the region can show more reliable data on customer preferences.

In Turkey there is still a need to obtain data to identify and improve the meat production ability of sheep breeds/hybrids in qualitative and quantitative terms. In this context, analysis of the meat quality of Kıvırcık lambs reared by farmers in Eşme and its vicinity will contribute to the literature and future studies.

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