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Effects of feeding in different quality rangelands on meat quality and fatty acids composition in Angora goat kids and young bucks

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Abstract: The effects of feeding in different quality rangelands on meat quality and fatty acids composition in Angora goat kids and bucks were determined. Twenty male Angora goat kids were selected from each farm that produces Angora goats in the area. There are three separate rangelands with previously determined quality classes (good, medium, and low-quality). In each farm, among these animals grazed completely on the rangeland, 7 heads from 4-month-old kids and 7 heads from 7-month-old bucks were selected and slaughtered. The Longissimus thoracis muscle was removed for meat quality measurement. The increased rangeland quality increased the protein content of kid's meat, and dry matter, protein, and ash contents of buck meat ($p < 0.05$). Cooking loss was highest in bucks grazing on low-quality rangeland but water-holding capacity was highest in good-quality rangeland ($p < 0.05$). While the L* value of kid meat grazing on good-quality rangeland was higher than those grazing on low-quality rangeland, the b* value was found to be lower ($p < 0.05$). The b*, c*, and H* values of buck meat grazing on good-quality rangeland increased significantly compared to those grazing on low-quality rangeland. Rangeland quality did not cause any change in the L* and a* values of meat in bucks and a*, c*, and H* values in kids. The effects of rangeland quality on tenderness, hardness, and shear force of meat were insignificant in kids. The effects on tenderness and hardness of grazing on the rangeland were insignificant, but the shear force of buck meat grazing on low-quality rangeland was higher than those grazing on better qualified rangelands ($p < 0.05$). While the levels of saturated fatty acids such as butyric, lauric, myristic, palmitic, heptadecanoic, and stearic acid of kids and bucks grazing on low-quality rangelands are higher ($p < 0.05$) than kids and bucks grazing on good-quality rangelands, unsaturated fatty acids such as oleic, linoleic and linolenic acid were found to be lower. ($p < 0.05$). In conclusion, rangeland quality partially affects positively meat quality and fatty acid content in 4-month-old Angora goat kids and 7-month-old bucks.

Keywords: Angora goat kids, bucks, rangeland, meat quality, fatty acids

1. Introduction

The interest in goats and products obtained from goats in the world has increased in recent years in terms of both producer and consumer demand. Goat meat production in Turkey constitutes 4.8% of the total red meat production. While Hair goats constitute 97.65% of the total goat population in Turkey, Angora goats constitute 2.35% [1]. Goats are animals that have high adaptability to different environmental conditions, can evaluate various food sources, and have high resistance to some diseases [2]. Goat farming is, also, an important source of income in developing countries [3]. Due to the rapid growth of the human population, goats are ruminant animals that may contribute to their increased protein requirements [4]. Goats have small mouths and slit upper lips, making it easy for them to collect small leaves, flowers, fruits, and other plant parts, in addition, goats are very active and selective, able to roam a large area in search of scarce plant material. They have the advantage of benefiting from small plants and leaves with high protein content and high digestibility sandwiched between thorny and woody stems, and rejecting low-quality plants. Goats can reach every top of trees standing on their hind legs, and may, also, eat unpleasant weeds due to their bitter compounds such as tannins [5].

Angora goat was brought to Anatolia by the Turks from Central Asia in the 13th century and gained its most distinctive features in and around Ankara, the most important yield is mohair [6]. The decrease in the demand for mohair negatively affected the Angora goat breeding. Thus, the meat yield obtained from Angora goats has gained importance. However, the Angora goat is a small-sized and late-developing breed [7]. Angora goat breeding is generally done on rangeland in Turkey. In addition, goats, also, benefit from fallow, stubble, and areas not suitable for plant production, bush, oak, and maquis areas. Angora

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goats are, also, rangeland animals. In addition, Angora goat breeding in areas deprived of rangeland opportunities is, also, not economical. Rangeland grazing is the best practice for animal health and economic nutrition [2].

Goat meat is one of the most widely consumed red meats around the world, especially in Asia, Africa and Pacific countries. Geographic region, economic situation, traditional habits, and personal preferences affect goat meat consumption. The demand for goat meat is increasing worldwide. Goat meat is considered to be low-fat and suitable meat in terms of its nutritive value as well as its sensory qualities [8]. According to Teixeira et al. [9], the most popular meat is obtained from lambs and kids up to 3-month-old and 9-month-old with a carcass weight of 5–8 kg, or lambs and kids between 6 and 9-months old-and a carcass weight of more than 11 kg. When the rangeland quality decreases in summer, Angora goats have more advantageous than sheep because they can use poor-quality grass better and better utilize and digest low-quality rangelands [2]. The meat of Angora goats is crispy and, delicious without any odor. For this reason, some consumers prefer young animal meat to old animal meat. Although Angora goats are generally grazed on rangeland, there have been not enough studies on meat quality and meat fatty acid composition of kids and bucks grazing on different quality rangeland. It is thought that grazing in the rangeland at different ages will affect the meat quality. Therefore, in this study; the effects of feeding on different quality rangeland on meat quality and fatty acids in Angora goat 4-month-old kids and 7-month-old bucks were determined.

2. Materials and methods

2.1. Materials

Considering the botanical structure and nutrient composition of the rangelands in the west of Ankara, 3 different quality rangelands were selected. These are 1) Ayaş- Başbereket good-quality rangeland (coordinates; 40° 5' 59.6112" N and 32° 24' 9.0540" E, altitude; 1200 m (17.80 %HP), 2) Ayaş-Ilıca village, medium-quality rangeland (coordinates; 40° 3' 23.6592" N and 32° 15' 31.4748" E, altitude; 750 m (16.58 %HP), 3) Nallıhan-Çayırhan, low-quality rangeland (coordinates; 40° 5' 49.4736" N and 31° 40' 41.5668" E, altitude; 503 m (13.48% HP) [10]. An enterprise that breeds Angora goats was determined in each rangeland area. A total of 60 animals, 20 of which are single male kids, were determined separately from each farm. To determine meat quality and fatty acids, 7 heads from 4-month-old kids and 7 heads from 7-month-old bucks were randomly selected for each farm with different quality rangeland, thus, a total of 42 animals were slaughtered, 21 heads from 4-month-old kids and 21 heads from 7-month-old bucks.

2.2. Methods

The procedures performed on the animals used in the research were conducted in accordance with the Ankara University Animal Experiments Ethics Committee (2016-8-83-430/3642).

This study was conducted in 2016–2020. In each farm, the kids who stayed with their mothers for 1 month from birth, then went out to the rangeland with their mothers and were completely grazed in the rangeland after they were weaned at the age of 2 months. The animals easily reached the water source in the rangeland.

2.2.1. Determination of meat quality

Meat quality of kids and bucks slaughtered at 4 and 7 months old was determined on meat samples taken from the Longissimus thoracis (LT) muscle between the 6th and 13th ribs. Meat samples were placed in vacuum bags and kept in the refrigerator at 4 °C for 5 days until analysis. Dry matter (DM), protein, ether extract (EE), and ash analysis of meat were made according to AOAC [11]. The initial pH (pH_0) of the meat was determined in the LT muscle as soon as the animal was slaughtered. pH_{24} was measured after raw meat was kept for 24 h at 4 °C in the refrigerator. pH measurements were measured with a pH-meter (using Orion 9106 glass pen electrode and Orion 210A pH-meter). L* (brightness), a* (redness), and b* (yellowness), c* (chroma), hue (H*) parameters were determined in muscle slices 48 h after slaughter by Minolta CR 600 colorimeter according to the CIE system, (Konica Minolta, Osaka, Japan). To determine the cooking loss (CL) (%), 50 g raw meat was placed in a ziplock bag, and kept in a water bath until reached 75 °C temperature of the meat, bags were then cooled with running tap water for about 30 min until cool, the meats were removed from the bag, dried, and weighed [12]. The water holding capacity (WHC) was determined according to the method of Grau and Hamm [13]. For this purpose, 0.5 g of meat was placed between filter paper, the weight of which was determined beforehand. After these were placed between the glass plates, 1 kg of meat was placed on them for 20 min, the meat was then removed and the filter paper was weighed again. The texture analyses (tenderness, hardness, and shear force) of meats were determined with a texture analyzer (TA-HD Plus Texture Analyzer, UK), for which a 5 kg load cell was used. Meats prepared in the same way as CL determination were cut into 30 mm × 30 mm × 40 mm cubes (repeated 5 times for each sample). Tenderness was determined using 1" dia ball ss 70 mm long probes. Hardness measurement was made with needle probes with a 2 mm diameter and 25 mm height adjusted to 20 mm penetration depth. Kramer Shear Cell 5 blades probes were used to measure SF N (Newton). Analyzes were performed with fife replications for each criterion in the meat samples taken from the LT muscle of each slaughtered animal.

2.2.2. Determination of fatty acids

While the method of Bligh and Dyer [14] was used for the extraction of lipids, the method of Folch [15] was used to determine fatty acid methyl esters. The samples were extracted with a chloroform/methanol mixture (2:1, v/v). The fatty acid compositions were determined by gas chromatography with a flame ionization detector (FID) and DB-23 column (60 m × 0.25 mm I.D., 0.25 µm) Shimadzu brand (Model GC-2010, Japan). Fatty acids were defined by comparing depending on the arrival times of the FAME mixture (Supelco 37 Components FAME Mixture, Cat. No. 18919-1AMP, Bellefonte PA, USA) which consists of standard 37 components. Fatty acid analyses were performed with 5 replications in each meat sample taken from each kid and buck slaughtered at 4 months and 7 months of age.

2.3. Statistical analysis

For the nutrient composition, quality criteria and fatty acid properties of the meat of Angora goat kids and bucks grazing on the rangeland, the assumption of normality of the data was made with the Shapiro Wilk test, the homogeneity of the variances was determined with the Levene test and it was determined that the data were suitable for analysis of variance ($p > 0.05$). The analysis of the data obtained in the research was made with a one-way analysis of variance and the differences between rangelands were estimated by Duncan multiple comparison test [16,17]. All values are expressed as mean and standard deviation. SPSS 22 package program was used in the analysis of the data. The test was performed at a $p \leq 0.05$ significance level.

3. Results

3.1. Meat quality of 4-month-old Angora goat kids and 7-month-old bucks

3.1.1. Chemical composition of meat

The chemical composition of the meat of 4-month-old Angora goat kids and 7-month-old bucks grazing on three different rangelands is given in Table 1.

Table 1 shows that the rangeland quality has no significant effect on the DM, EE, and ash content of the meat of 4-month-old Angora goat kids. However, the rangeland quality positively affected the protein content of the meat. The protein content in kid's meats grazing on good-quality rangelands was determined the highest compared to those grazing on medium and low-quality rangelands ($p < 0.05$), the lowest protein was determined in the meat of those grazing on low-quality rangeland ($p < 0.05$). Improvement of rangeland quality resulted in an increase in DM, protein, and ash content in buck meat. While the DM, protein, and ash contents of the meat of bucks grazing on good-quality rangeland were found to be higher ($p < 0.05$) than those grazing on medium and low-quality rangeland. The effect on EE content of the kid and buck meats of rangeland quality was not significant.

3.1.2. pH, cooking loss, and water-holding capacity of meat

The pH, CL, and WHC values of meat of 4-month-old Angora goat kids and 7-month-old bucks grazing on rangeland are given in Table 2.

The pH_0 value of Angora goat kid and buck meats changed between 6.53–671 and 6.56– 6.71, pH_{24} values changed between 5.51–5.57 and 5.45–5.58 and the rangeland quality had no significant effect on pH_0 and pH_{24}.

The effect of rangeland quality on CL and WHC values in kid meats was found to be insignificant. The CL value of the bucks grazing on low-quality rangelands was found to be significantly higher than those grazing on good and medium-quality rangelands ($p < 0.05$). On the contrary, WHC values in the meat of bucks grazing on good-quality rangelands were highest compared to those grazing on medium and low-quality rangelands ($p < 0.05$). WHC value decreased as rangeland quality decreased.

Table 1. Chemical composition of meats of 4-month-old Angora goat kids and 7-month-old bucks grazing on rangeland (as is, %).

Rangeland quality	Dry matter	Protein	Ether extract	Ash
4-month-old kids				
Good	24.79 ± 1.57	19.68 ± 0.01^a	1.59 ± 0.05	3.51 ± 0.56
Medium	24.28 ± 1.16	19.16 ± 0.02^b	1.61 ± 0.03	3.50 ± 0.21
Low	23.51 ± 2.33	18.34 ± 0.08^c	1.55 ± 0.04	3.62 ± 0.27
p-values	0.864	0.000	0.552	0.07
7-month-old bucks				
Good	26.78 ± 0.09^a	21.06 ± 0.07^a	1.84 ± 0.13	3.88 ± 0.03^a
Medium	25.69 ± 0.01^b	20.35 ± 0.17^b	1.88 ± 0.24	3.45 ± 0.13^b
Low	25.77 ± 0.07^b	20.41 ± 0.14^b	1.78 ± 0.07	3.58 ± 0.15^b
p-values	0.002	0.001	0.356	0.001

a,b,c. means with different letters in the same column differ significantly ($p < 0.05$)

Table 2. pH, cooking loss and water holding capacity of meats of 4-month-old Angora goat kids and 7-month-old bucks grazing on rangeland.

Rangeland quality	pH_0	pH_{24}	CL, %	WHC, %
	4-month-old kids			
Good	6.53 ± 0.10	5.51 ± 0.05	25.85 ± 1.82	35.15 ± 1.13
Medium	6.61 ± 0.07	5.56 ± 0.05	28.8 ± 1.32	34.11 ± 2.15
Low	6.71 ± 0.09	5.57 ± 0.04	32.2 ± 3.56	34.77 ± 1.19
p-values	0.369	0.272	0.464	0.257
	7-month-old bucks			
Good	6.56 ± 0.06	5.46 ± 0.08	26.76 ± 0.22^b	37.15 ± 0.01^a
Medium	6.71 ± 0.09	5.45 ± 0.09	29.34 ± 0.14^c	35.76 ± 0.12^b
Low	6.62 ± 0.10	5.58 ± 0.07	33.21 ± 0.63^a	32.22 ± 0.02^c
p-values	0.433	0.997	0.001	0.003

a,b,c.. means with different letters in the same column differ significantly ($p < 0.05$)
CL: Cooking loss, WHC: Water holding capacity

3.1.3. Color properties of meat

Color characteristics of the meat of Angora goat 4-month-old kids and 7-month-old bucks are given in Table 3.

The effect of rangeland quality on the L* and b* values of kid meat was found to be significant. L* value was significantly higher in the meat of kids grazing on good-quality rangeland ($p < 0.05$) compared to those grazing on low-quality rangeland, but there was no statistically significant difference between those grazing medium-quality rangeland and the other groups. The b* value was found to be higher in the meat of kids grazing on low-quality rangeland than those grazing on good and medium-quality rangeland ($p < 0.05$). The effect of rangeland quality on the a* and c* and H* values of the kid meat was insignificant.

According to Table 3, the effect of rangeland quality on the L* and a* values of the Angora goat buck's meat was insignificant. While the b* value was found to be higher in the meat of bucks grazing on low-quality rangeland than those grazing on medium and good-quality rangeland ($p < 0.05$), no statistically significant difference was determined between bucks grazing on good and medium-quality rangeland. The c* and H* values of meat were found to be lowest in those grazing on good-quality rangeland and the highest in those grazing on low-quality rangeland, and the difference between them was significant ($p < 0.05$).

3.1.4. Textural characteristics of meat

The texture characteristics determined in the meat taken from the LT muscle of 4-month-old Angora goat kids and 7-month-old bucks grazing in three different rangelands are given in Table 4.

Table 4 shows that the effect of rangeland quality on tenderness, hardness, and shear force was not significant in kid meat. However, the tenderness, hardness, and shear force in the meat of kids grazing on good-quality rangeland are numerically lower than the others.

The effect of rangeland quality on the tenderness and hardness of buck meats was found to be insignificant, however, the shear force of the bucks grazing on low-quality rangeland was higher than those in the other two rangeland groups ($p < 0.05$), There was no significant difference between the tenderness and hardness values of the meat of bucks grazing on good and medium-quality rangeland. However, the decrease in rangeland quality caused an increase in the shear force value of the buck.

3.2. Fatty acid composition of the 4-month-old kids and the 7-month-old buck meat

The fatty acids determined in the meats taken from the LT muscle of the 4-month-old Angora goat kids and the 7-month-old bucks grazing on the rangeland are given in Tables 5 and 6.

The effect of rangeland quality on some fatty acids of meats of kids was significant (Table 5). Butyric acid, lauric acid, myristic acid, palmitic acid, palmitoleic acid, cis-10heptadecanoic acid, and stearic acid were higher in the kid's meat grazing on low-quality rangelands compared to those grazing on good and medium-quality rangelands ($p < 0.05$). Thus, according to the results in Table 5, it was determined that the saturated fatty acids were higher in kids grazing on low-quality rangeland compared to those grazing on good and medium-quality rangeland.

Elaidic acid was found to be the highest in the meat of kids grazing on medium-quality rangeland compared to those grazing on good and low-quality rangelands ($p < 0.05$). Heptadecanoic acids were found the highest ($p < 0.05$) in the meat of kids grazing on medium and low-quality rangeland.

Table 3. Color characteristics of meats of Angora goat 4-month-old kids and 7-month-old bucks grazing on rangeland.

Rangeland quality	L*	a*	b*	c*	H
	4-month-old kids				
Good	45.79 ± 0.82[a]	14.4 ± 0.52	4.15 ± 0.40[b]	14.98 ± 0.49	16.07 ± 1.58
Medium	44.69 ± 0.45[ab]	14.71 ± 0.24	4.04 ± 0.31[b]	15.25 ± 0.36	15.35 ± 2.01
Low	42.09 ± 1.30[b]	14.86 ± 0.55	5.45 ± 0.27[a]	15.83 ± 0.58	20.14 ± 2.49
p-values	0.03	0.775	0.013	0.763	0.690
	7-month-old bucks				
Good	44.66 ± 1.07	16.51 ± 0.67	4.65 ± 0.25[b]	17.15 ± 0.47[b]	15.73 ± 2.08[b]
Medium	42.95 ± 0.55	16.17 ± 0.58	5.27 ± 0.44[b]	17.01 ± 0.59[ab]	18.05 ± 1.35[ab]
Low	44.8 ± 0.59	17.36 ± 0.52	6.64 ± 0.48[a]	18.59 ± 0.57[a]	20.93 ± 1.11[a]
p-values	0.197	0.255	0.008	0.099	0.073

a,b,c.. means with different letters in the same column differ significantly ($p < 0.05$)

Table 4. Textural characteristics of meats of 4-month-old Angora goat kids and 7-month-old bucks grazing on rangeland, (N).

Rangeland quality	Tenderness	Hardness	Shear force (Kramer Shear Cell 5 blades)
4-month-old kids			
Good	23.82 ± 40.59	26.31 ± 24.48	32.84 ± 10.87
Medium	24.68 ± 44.52	29.71 ± 22.46	35.06 ± 18.85
Low	26.95 ± 22.14	34.86 ± 26.31	40.56 ± 35.21
p-values	0.981	0.203	0.353
7-month-old bucks			
Good	26.57 ± 19.35	28.86 ± 54.71	38.11 ± 1.35[b]
Medium	31.71 ± 46.32	31.61 ± 31.46	40.24 ± 1.51[b]
Low	40.4 ± 26.94	36.65 ± 34.95	44.13 ±1.61[a]
p-values	0.380	0.877	0.002

a,b,c.. means with different letters in the same column differ significantly ($p < 0.05$), N: Newton

Oleic, linolelaidic acid, linoleic acid, arachidonic acid (C20:0), cis-8,11,14eicosatrienoic acid, cis-5,8,11,14,17-eicosapentaenoic acid, cis- 4,7,10,13,16,19-decosahexaenoic acid was found to be higher in kids grazing good-quality rangeland compared to the other two rangeland groups ($p < 0.05$), however, cis-11-eicosenic acid, heneicosanic acid, behenic acid, arachidonic acid (C20:4n4), tricosanoic acid, lignoceric acid were found to be lower in the meat of kids grazing on low-quality rangeland compared to the other rangeland groups ($p < 0.05$). Grazing on good-quality rangeland of kids caused an increase in unsaturated fatty acids in the meat.

Table 6 shows that the effect of rangeland quality on some fatty acids of buck meat was significant.

According to Table 6, it was observed that the effect of rangeland quality on some fatty acids of buck meats was significant. When the fatty acid composition of the buck meats was evaluated, butyric acid, capric acid, myristic and palmitic acid, and cis-10-heptadecanoic acid were found to be significantly higher in the meat of the bucks grazing on low-quality rangeland ($p < 0.05$), but, no significant difference was found between those grazing on good and medium-quality rangelands. Heptadecanoic acid was found to be significantly higher in the meat of bucks grazing on medium-quality rangeland compared to those grazing on good and low-quality rangeland ($p < 0.05$). Linolelaidic acid was higher in bucks grazing on good and low-quality rangeland ($p < 0.05$). While the highest heneicosanic acid, cis-11,14-eicosadienoic acid, cis11,14,17-eicosatrienoic acid, and arachidonic acid

Table 5. Fatty acid compositions of meats of 4-month-old Angora goat kids grazing on rangeland (g/100 g lipid).

Fatty acids	Rangeland quality			p-values
	Good	Medium	Low	
Butiric acid (C4:0)	0.17 ± 0.02[b]	0.16 ± 0.03[b]	0.23 ± 0.06[a]	0.001
Caproik acid (C6:0)	0.02 ± 0.01	0.01 ± 0.01	0.01 ± 0.01	0.657
Caprilik acid (C8:0)	0.015 ± 0.005	0.009 ± 0.004	0.013 ± 0.005	0.392
Capric acid (C10:0)	0.11 ± 0.12	0.18 ± 0.06	0.14 ± 0.06	0.149
Underconoic acid (C11:0)	0.01 ± 0.04	0.07 ± 0.06	0.02 ± 0.16	0.477
Lauric acid (C12:0)	0.15 ± 0.04[b]	0.14 ± 0.24[b]	0.27 ± 0.33[a]	0.001
Tridecanoic acid (C13:0)	0.02 ± 0.01	0.16 ± 0.13	0.06 ± 0.01	0.420
Myristic acid (C14:0)	1.64 ± 0.35[c]	1.42 ± 0.59[b]	2.13 ± 0.68[a]	0.00
Myristoleic acid (C14:1)	0.3 ± 0.13	0.03 ± 0.01	0.2 ± 0.03	0.071
Cis-10-pentadecanoic acid (C15:1)	0.23 ± 0.04	0.17 ± 0.02	0.1 ± 0.03	0.132
Palmitic acid (C16:0)	16.58 ± 0.15[c]	19.6 ± 0.06[b]	21.09 ± 0.08[a]	0.00
Palmitoleic acid (C16:1)	0.51 ± 0.12[b]	0.78 ± 0.08[b]	1.03 ± 0.15[a]	0.00
Heptadecanoic acid (C17:0	1.55 ± 0.08[b]	2.09 ± 0.13[a]	2.06 ± 0.07[a]	0.001
Cis-10heptadecanoic acid (C17:1)	0.26 ± 0.04[b]	0.31 ± 0.05[b]	0.46 ± 0.05[a]	0.00
Stearic acid (C18:0)	16.73 ± 0.13[c]	23.92 ± 0.17[b]	26.01 ± 0.06[a]	0.009
Elaidic acid (C18:1n9t)	1.29 ± 0.23[b]	1.87 ± 0.18[a]	1.25 ± 0.10[b]	0.001
Oleic acid (C18:1n9t)	32.72 ± 0.62[a]	27.4 ± 0.39[b]	23.03 ± 0.23[c]	0.002
Linolelaidic acid (C18:2)	0.41 ± 0.01[a]	0.04 ± 0.01[b]	0.02 ± 0.01[c]	0.00
Linoleic acid (C18:2n6c)	14.95 ± 0.12[a]	14.03 ± 0.11[b]	9.92 ± 0.46[c]	0.043
Arachidonic acid (C20:0)	0.42 ± 0.02[a]	0.37 ± 0.01[b]	0.29 ± 0.02[c]	0.00
Gama-linoleic acid (C18:3n6)	0.16 ± 0.01	0.14 ± 0.01	0.08 ± 0.01	0.057
Cis-11-eicosenic acid (C20:1)	0.17 ± 0.01[a]	0.16 ± 0.02[a]	0.12 ± 0.01[b]	0.003
heneicosanic acid (C21:0	0.95 ± 0.16[a]	1.15 ± 0.06[a]	0.55 ± 0.07[b]	0.001
Cis-11,14-eicosadienoic acid (C20:2)	0.09 ± 0.01	0.09 ± 0.01	0.06 ± 0.01	0.338
Behenic acid (C22:0)	0.05 ± 0.01[a]	0.04 ± 0.02[a]	0.02 ± 0.01[b]	0.00
Cis-8,11,14eicosatrienoic acid (C20:3n6)	1.29 ± 0.11[a]	0.92 ± 0.06[b]	0.32 ± 0.06[c]	0.010
Erucic acid (C22:1n9)	0.02 ± 0.02	0.03 ± 0.01	0.01 ± 0.02	0.157
Cis11,14,17-eicosatrienoic acid (C20:3n3)	0.05 ± 0.03	0.04 ± 0.02	0.02 ± 0.02	0.055
Arachidonic acid (C20:4n4)	0.06 ± 0.01[a]	0.06 ± 0.01[a]	0.04 ± 0.01[b]	0.00
Tricosanoic acid (C23:0)	5.93 ± 0.08[a]	4.17 ± 0.11[a]	1.82 ± 0.039[b]	0.00
Lignoceric acid (C24:0)	0.17 ± 0.02[a]	0.12 ± 0.02[a]	0.05 ± 0.01[b]	0.00
Cis-5,8,11,14,17-eicosapentaenoic acid (C20:5n3EPA)	2.36 ± 0.22[a]	1.5 ± 0.21[b]	0.62 ± 0.16[c]	0.00
Cis-4,7,10,13,16,19-decosahexaenoic acid(C22:6n3DH)	0.43 ± 0.04[a]	0.28 ± 0.04[b]	0.16 ± 0.03[c]	0.00

a,b,c.. means with different letters in the same column differ significantly ($p < 0.05$)

(C20:4n4) were determined in the meat of bucks grazing on good-quality rangeland, it was the meat of bucks grazing, the lowest was found in goat meat of those grazing on low-quality rangeland, and the difference between them was significant ($p < 0.05$). Behenic acid was found to be significantly higher in the meat of bucks grazing on good and medium-quality rangeland than those grazing on low-quality rangeland ($p < 0.05$). According to these results, grazing on good-quality rangeland of bucks caused an increase in unsaturated wet acids (such as arachidonic,

Table 6. Fatty acid compositions of meats of 7-month-old Angora goat bucks grazing on rangeland (g/100 g lipid).

Fatty acids	Rangeland quality			p- values
	Good	Medium	Low	
Butiric acid (C4:0)	0.25 ± 0.04^b	0.28 ± 0.02^b	1.19 ± 0.42^a	0.002
Caproik acid (C6:0)	0.3 ± 0.05	0.11 ± 0.02	0,17 ± 0.01	0.096
Caprilik acid (C8:0)	0.16 ± 0.01^c	0.18 ± 0.02^b	0.21 ± 0.03^a	0.001
Capric acid (C10:0)	0.04 ± 0.02^b	0.08 ± 0.01^b	0.18 ± 0.03^a	0.00
Lauric acid (C12:0)	0.14 ± 0.02	0.43 ± 0.01	0.33 ± 0.05	0.105
Myristic acid (C14:1)	1.88 ± 0.14^b	1.74 ± 0.16^b	2.63 ± 0.14^a	0.002
Palmitic acid (C16:0)	19.96 ± 0.07^b	19.91 ± 0.03^b	22.05 ± 0.05^a	0.001
Palmitoleic acid (C16:1)	1.49 ± 0.19	1.06 ± 0.11	1.19 ± 0.09	0.115
Heptadecanoic acid (C	1.32 ± 0.13^b	1.86 ± 0.08^a	1.01 ± 0.23^b	0.001
Cis-10heptadecanoic acid (C17:1)	0.58 ± 0.1^b	0.54 ± 0.11^b	1.37 ± 0.07^a	0.00
Stearic acid (C18:0)	19.79 ± 1.17	21.57 ± 0.91	20.38 ± 0.6	0.400
Elaidic acid (C18:1n9t)	1.34 ± 0.12	1.41 ± 0.21	1.79 ± 0.08	0.103
Oleic acid (C18:1n9t)	28.95 ± 0.68	26.64 ± 1.83	28.24 ± 1.46	0.508
Linolelaidic acid (C18:2)	0.46 ± 0.18^a	0.05 ± 0.01^b	0.54 ± 0.15^a	0.041
Linoleic acid (C18:2n6c)	11.76 ± 1.68	12.05 ± 0.86	12.23 ± 1.05	0.966
Arachidonic acid (C20:0)	0.48 ± 0.22	0.45 ± 0.01	0.18 ± 0.02	0.203
Gama-linoleic acid (C18:3n6)	0.27 ± 0.15	0.11 ± 0.01	0.46 ± 0.20	0.260
Cis-11-eicosenic acid (C20:1)	0.16 ± 0.01	0.14 ± 0.01	0.27 ± 0.06	0.056
Heneicosanic acid (C21:0	1.7 ± 0.36^a	0.99 ± 0.02^{ab}	0.77 ± 0.22^b	0.003
Cis-11,14-eicosadienoic acid(C20:2)	0.4 ± 0.08^a	0.06 ± 0,01^b	0.09 ± 0.01^b	0.00
Cis-11-eicosenic acid (C20:1)	0.06 ± 0.03	0.06 ± 0.01	0.06 ± 0.02	0.844
Behenic acid (C22:0)	1.11 ± 0.05^a	1.31 ± 0.01^a	0,6 ± 0,06^b	0.001
Cis-8,11,14eicosatrienoic acid (C20:3n6)	0.03 ± 0.02	0.03 ± 0.01	0.03 ± 0.01	0.104
Erucic acid (C22:1n9)	0.10 ± 0.05	0.25 ± 0.06	0.10 ± 0.07	0.368
Cis11,14,17-eicosatrienoic acid (C20:3n3)	0.42 ± 0.16^a	0.08 ± 0.02^b	0.06 ± 0.03^b	0.00
Arachidonic acid (C20:4n4)	6.03 ± 0.42^a	4.68 ± 0.29^b	1.88 ± 0.44^c	0.03
Lignoceric acid (C24:0))	0.15 ± 0.02	0.13 ± 0.04	0.15 ± 0.06	0.175
Cis-5,8,11,14,17-eicosapentaenoic acid (C20:5n3EPA)	2.05 ± 0.17	1.67 ± 0.17	1.6 ± 0.18	0.062
Cis-4,7,10,13,16,19-decosahexaenoic acid(C22:6n3DH)	0.36 ± 0.05	0.61 ± 0.06	0.27 ± 0.15	0.132

a,b,c.. means with different letters in the same column differ significantly ($p < 0.05$)

Cis-11,14-eicosadienoic acid (C20:2) fatty acids), while grazing on low-quality rangeland caused an increase in saturated fatty acids (such as Capric, myristic, palmitic).

4. Discussion

4.1. Meat quality of Angora Goats kids and bucks

The meat quality is affected by the species, breed, age, sex, physiological period of the slaughtered animal, biochemical reactions in the muscles after slaughter, storage conditions, rearing system, feeding status, feed content, muscle, fat and fatty acids ratio, and genetic factors.

Meat quality characteristics are affected by many factors such as the type, breed, age, sex, physiological period of the slaughtered animal, biochemical reactions in the muscles after slaughter, storage conditions, breeding system, feeding status, feed content, muscle, fat and fatty acids ratio, and genetic factors [8,18].

4.1.1. Chemical composition of meat

The effect of rangeland quality in terms of DM, EE, and ash in the LT muscle of kids was not significant, but the protein content of meat was positively affected by rangeland quality. The effect of rangeland quality on DM, protein, and ash content was significant in meat of bucks grazing on good and medium-quality rangeland. In this study, DM contents in the meat of kids and bucks varied between 23.51%–24.79% and 25.69%–26.78%, respectively. Since there was no study on the meat quality of Angora goat 4-month-old kids fed on different quality rangeland, comparisons were made with the studies conducted with the other goat breeds. The DM content of Angora goat kid and buck meat is lower than results reported by Alexander et al. [19], for the meat of 4-month and 8-month-old Creole kids fed on rangeland (32%; 33.3%), and Aplociana et al. [20] for the meat of 9-month-old Boer kids (31.8%–27%). As the age of the animals increases, the dry matter content of the meat increases. The decrease in moisture content in meat may be due to the increase in fat content in meat, as well as age-related. The fat content of young animal meats is low because as the age progresses and the growth is completed, the excess nutrients taken will be stored as fat in the body, so the fat increases, and the DM content of the meat also rises [2]. In addition, the structure, water content, and nutrient composition of the feed can also affect the DM content of the meat [2,8,10]. In the current study, the protein content of kid and buck meats ranged from 18.34% to 19.68% and from 20.35% to 21.06%, respectively. These results were within the range (17%–29.2%) reported by Webb et al. [8]. The meat water content (76.54%) in goat grazing in the study of Kawęcka and Pasternak [21] is similar to our result of 4-month-old kids grazing on low-quality rangeland with similar, protein content (20.84%) of 7-month-old bucks grazing on good-quality rangeland in the current study. The results obtained from 4-month-old Angora goat kids are compatible with the results of Aplocina et al. [20] who found that the protein content of 9-month-old Boer goat meat fed with oats is 19.3%–19.6%. Good-quality rangeland plants in our study have high protein content [10]. According to the results of this study, the increase in the rangeland due to the high protein content of the rangeland plants caused an increase in the protein content of the kid and buck meat. In the study, while the EE content of kid and buck meats was determined between 1.55%–1.61% and 1.78%–1.88%, the ash content was determined in the range of 3.50%–3.62% and 3.45%–3.88%. The LT muscle fat content (3.07%) determined by Rodriguez et al. [22] for kids grazing on rangeland is higher than our findings. In addition, the ash content of the meats is lower than the results reported by Turner et al. [23] for goat meat grazing in the rangeland (4.3%–4.4%), but are consistent with the findings of Webb et al. [8] for goat meat (0.95%–3.4%). The ash content of the meat may be affected by the botanical diversity, quality, and soil characteristics of the rangelands. According to Mostert and Hoffman, [24], the mineral content of meat can be affected by various factors such as the mineral concentration of the diet, hormones, age, species, and region. In studies, moisture, protein, and fat values in the meat of Majorera kids at different slaughter weights [25] and French Alpine kids [26] are similar to the results of kids and bucks in this study, however, the researchers' findings for ash are lower than that of our study. Some studies reported that diet type, sex, age, and genotype affect the moisture, fat, protein, and ash content of meat [27,28]. In the study of Marichal et al. [29], moisture (76.30%–78.55%) and protein (18.55%–20.75%) contents obtained in the meat of Canary Goats are similar to the results of this study, but fat (0.96%–1.3%) and ash (1.08%–1.16%) contents are lower. In contrast, Dieters et al. [30] reported that rangeland-grazing of Australian goats had no effect on the fat and ash content of the meat, but did affect the moisture and protein content. In the current study, the difference in rangeland quality affected the DM, mineral, and protein content of buck meat. On the other hand, grazing on the rangeland in kids had no significant effect on other nutrients (except protein) of meat. The reason for the differences between the research results could be related to variations in breed, age, slaughter weight as well as the fed level such as rangeland quality.

4.1.2. pH, cooking loss, and water holding capacity of meat

The meat quality is affected by the breed, age, sex, slaughter weight and feeding level of the animal. Besides color and tenderness, pH is also meat's most important characteristic because pH affects shear force, WHC, CL, flavor, and color [8, 31]. In this study, the first pH (pH_0) and 24 h later pH (pH_{24}) values of animals slaughtered at 4 and 7-months of age were determined in the ranges of 6.53–6.71, 6.56–6.71 and 5.51–5.57, 5.45–5.58, respectively. pH 24 values reported in literatures for Akkeçi goat, Hair goat, and Angora goat kids (5.69–5.86) castrated at different age [32], and Messinese goat kids pasture-fed (5.63) [33] are higher compared to the results of this study. Other researchers reported the final pH_{24} is in the range of 5.4–5.8 in quality meats [8,18,25]. According to Priola et al. [34], pH_{24} for kids grazing on rangeland is between 5.46 and 5.75. The pH_{24} results in our study remained within the limits specified by the researchers. The final pH value of meat is affected by many factors such as the animal's physiological state before slaughter, genotype, age, sex, body weight, fatness, nutrition and production system [35]. Rangeland quality did not have any negative effect on the pH_0 and pH_{24} values of the meat.

Cooking is a heat treatment applied to increase the consumption quality of meat by increasing its sensory properties, and to facilitate its preservation by reducing the microbiological effect [10]. In this study, CL ranged from 25.85 to 32.2% in kids and from 32.22 to 37.15% in bucks. No studies were found on the meat quality of Angora goat 4 month-old kids and 7 month-old bucks grazing on different quality rangeland. For this reason, comparisons were made with the results of different studies on different breeds and on the same breed. The CL value found for kids and bucks in the present study was higher than the CL values obtained by Şen et al. [36] for the Angora goat kid meat (22.86%), and by Kannan et al. [37] for 8-month-old Spanish goats fed with supplementary diet in the rangeland (14.2%). On the contrary, the obtained CL results for Angora goat kids and bucks in the present study was lower than showed by Rodriguez et al.[38] for the rangeland-fed goats (36.23%) and by Pratiwi et al. [28] for Australian wild male goats fed with roughage (43.5, 41.3 and 33.4%). On the other hand, the CL values observed in this study was similar to the one obtained by Liotta et al [33], who reported in Messinese kids fed completely on rangeland (CL:25.53). Dieters et al. [30] reported that rangeland-grazing had no effect on the CL of the meat of Australian goats. In our study, while grazing on the rangeland of kids had no effect on CL, but buck meat was affected by the rangeland quality. The decrease in rangeland quality caused an increase in CL. In general, the lower the CL, the better the juiciness of the meat. Differences in research results may have been due to the type of muscle from which the meat was sampled, the cooking temperature and time, as well as differences in the animal's feeding strategy. As a matter of fact, some researchers have stated that the differences in CL may be due to differences in cooking times and temperatures and the final pH value [22], the conditions the animal is exposed to before slaughter, and the biochemical reactions occurring in meat after slaughter [27].

WHC is the water-bound retention by meat proteins. Contractions in muscle tissues after slaughter cause proteolysis and mobilization of water in the extracellular spaces and release of some water. In the study, WSC ranged from 34.11% to 34.15% in kid meat and 32.22% to 37.15% in buck meats. Rangeland quality did not significantly affect the WHC value of meat in kids but affected that of buck. No study was found to determine the WHC value of Angora goat kids and bucks grazing on different quality rangelands. The WHC value obtained for Angora goat kids in this study was higher than the results of Şen et al. [36] in Angora goat kids fed with concentrated feed after weaning (13.8%), and of Bonvillani et al. [39] in Crillo Cordobes kids fed intensive conditions (29.93%–30.54%). On the contrary, the WHC values found by Marichal et al. by [29] in Canary goat kids are higher than the results of this study. The reason for the difference between the studies may be due to the differences in breed, age, live weight, and feeding type. WHC values were found to be close to each other due to the young age of the kids and bucks in our study and the lack of adiposity. The fact that the results of goats in different ages and feeding conditions are different in studies conducted with other breeds also supports our view.

4.1.3. Color properties of meat

Color, brightness, and fat level in the physical evaluation of meat; in the evaluation of its suitability for the palate, the crispness, taste, flavor, smell, the amount of connective tissue it contains and the level of fat release in the mouth during chewing are understood [8,18]. In this study, the values of L*, a*, b*, c*, and H* values in the kid meat changed between 42.09–45.79, 14.4–14.86, 4.04–5.45, 14.98–15.83, 15.35–20.14, respectively, these values for bucks was determined as 42.95–44.66, 16.17–17.36, 4.65–6.64, 17.01–18.59, 15.73– 20.14. The decrease in rangeland quality increased the yellowness value in the meat of kids and bucks. Since there was no study on 4-month-old Angora goat kids and 7-month-old bucks fed on rangeland, comparisons were made with other goat breeds. L* (40.4) and b* (3.7) values of the LT muscle determined by Pratiwi et al. [28] for Australian wild goat males with a slaughter weight of 20, kg were lower than the results of Angora goat kids and bucks in our study, but a* (15,1) is among the values of the kids and bucks in our study. The L* (46.1) determined by Priola et al. [34] for kids grazing on rangeland was similar to the results of kids grazing on good-quality rangeland, but the b* (9.79) was higher than the findings of this study, and the a* (7.60) was lower than the results of our study.

The L* and a* values obtained by Pena et al. [40] in Coriollo-Cordobes and Anglonubyan kids fed on rangeland after weaning were lower than our results, but b*, c*, and H* values were higher. L* value from the color parameters (L* = 46.18, a* = 16.64 and b* = 7.40) determined in Boer kid meat by Kaic et al. [41] was similar to the results of kids grazing on good-quality rangeland, and the a* value was also similar to the results of bucks in our study. The reason for the differences between the results of the studies is probably attributable to the differences in the breed of the animals, the slaughter age, the feeding of the animals, and the rangeland quality. In general, the muscles of animals fed in extensive conditions are harder and darker in color. Contrary to this view, Dieters et al. [30] stated that rangeland had no effect on meat color in Australian goats grazing on rangeland. In this study, a* value of 4-month-old kids is numerically lower than 7-month-old bucks. While growth and physical activity positively affect muscle development, thickening muscle fibers and connective tissue. Meats with high muscle myoglobin levels have a darker color [18,29]. Some researchers state that meat color is affected by factors such as the animal's type, breed, age, live weight, sex, nutrition, the place where the meat is taken from the carcass, the size of the piece, contact with the air, and drying on the surface and deterioration of the meat surface. In addition, also, state that the meat of the older and heavier animals is darker than the younger ones because they contain more muscle myoglobin [25–29].

4.1.4 Textural characteristics of meat

Color, shine and fat level in the physical evaluation of meat; in the evaluation of its suitability for palate, the crispness, taste, flavor, smell, the amount of connective tissue it contains and the level of fat release in the mouth during chewing are understood [8,18].

In the present study, it was seen that feeding 4-month-old Angora goat kids and 7-month-old bucks on rangeland partially affected the textural properties of meat (Table 4). The meat's tenderness is considered to be the most important determinant of meat quality. In this study, the tenderness was determined in the range of 23.82–26.95 N in kid meat and the range of 26.57–40.4 N in buck meat. These results are lower than results of Schonfeldt et al. [42] in Angora goats (45.76 N). Kadim and Mahgoub [43] stated that the meat of some breeds is softer due to the low collagen level in their muscles, as in Angora goats, which produce softer meat than Boer goats. Tenderness in meat may be affected from factors such as diet, grazing, the length of the feeding period, and animal age. As a matter of fact, according to some researchers, the breed of animal, type of feeding, age and muscle region are generally effective on the tenderness of the meat [18,28].

In our study, the hardness ranged from 26.31 to 34.86 N in kids, and from 28.86 to 48.13 N in bucks. The hardness of meat increased numerically according to the rangeland quality. It is also seen that the hardness of kid meat is lower than that of bucks. Young animals have more connective tissue per unit weight in their muscles. The type of connective tissue differs from that found in older animals, therefore, the meat of younger animals tends to be softer [44]. The hardness (65.11–75.12 N) determined by Migdal et al. [45] in 4 months old Carpathian and Saanen kids' meat is higher than that of our findings. The breed and weight of the animal, different feeding regimes such as rangeland grazing and intensive feeding, the type of muscle from which the meat is taken, the cooking temperature, the type of probe used during the measurement, and the rod cell strength applied may also be the reasons for the difference in meat hardness. In our study, the tenderness and hardness values of Angora goat kid and buck meats were found to be numerically lower in those grazing on good-quality rangelands compared to those grazing on medium and low-quality rangelands. The reason for the increase in the tenderness and hardness values of the meat, as the quality of the rangeland decreases, may be the decrease in the quality of the rangeland plants and the effort of the animals to find forage.

Current shear force values varied between 32.84–40.56 N for 4-month-old kids and 38.11–44.13 N for 7-month-old bucks. These results are lower than the findings obtained by Moawad et al. [46] for the kids of Egyptian Baladi goats (58 N). The shear force findings for kid meat in our study were lower than the results obtained by Kawecka and Pasternak [21] for kid meat (42.46–47.4 N), and by Umaraw et al. [47] for Barbari kids (45.51 N), but in agreement with the results of bucks. In this study, the effect of grazing in different quality rangeland on the shear force of kids was found to be insignificant. Similarly, Dieters et al. [30] also stated that grazing on rangeland did not affect shear force in Australian goats. While Destefanis et al. [48] classified meats with Warner–Bratzler shear force (WBSF) values greater than 52.68 N as tough, they found meats with WBSF values below 42.87 N to be similar to bovine LT muscle. According to this classification, in this study, it is seen that the meat of Angora goat kids is in the soft meat class due to the low cutting force. Likewise, the meat of bucks grazing on good-quality rangeland is in the soft meat class. The reason for the difference between the shear force results in the examined studies and the current study may be due to the type of feeding, animal breed, species, sex, age, location of the muscle from which the meat samples were taken, its preparation, the cooking temperature and time of the meat, tendon and connective tissue inclusions, and the final pH value [49].

4.2. Fatty acids composition of 4-month-old Angora goat kids and 7-month-old buck meats

In this study, it was observed that the rangeland quality affected some fatty acids in the meat. It was observed that the saturated fatty acids of Angora goat kids and bucks fed on low-quality rangeland were higher, and unsaturated fatty acids were higher in those fed on good-quality rangeland. Fatty acids are the main component of lipids and determine the degree of saturation of fats, which significantly affects their quality. Sarıçiçek [2] stated that FA composition is affected by nutrition. Raes et al. [50] stated that body tissues have more unsaturated fatty acids in rangeland-grazing goats than those fed with cereals, but the amounts of C16:0 and C18:0 fatty acids increase in parallel with this. Despite the high botanical diversity in the good-quality rangeland in this study, the lower plant population in the low-quality rangeland and the richness of shrub-type trees and leaves with high cellulose content [10] may have caused the short chain and saturated fatty acids to be higher. It is stated that nutrition and rearing systems affect fatty acid composition in muscle tissue more than genotype [51]. Since there was no study on the effects of feeding different quality rangeland on the meat fatty acid composition in Angora goats, 4-month-old kids and 7-month-old goats, the comparison was made with the studies conducted on other breeds and species. The oleic acid results obtained by Pena et al. [52] for the Criolla-Cordobes and Anglonubyan kids grazing on the rangeland were similar to the results of the kids in the current study, but higher than those of the 7-month-old bucks. Palmitic acid value determined in both breeds in the same study was higher than that of kids and bucks grazing good-quality rangeland in our study, but similar to the results of those grazing on medium and low-quality rangeland, in addition, stearic acid value determined for both breeds is lower than the results of Angora goat kids and bucks. The palmitic acid (21.0%) determined in the LT muscle of Serpentina kids grazing on natural rangeland by Belo et al. [53] is higher than the results of kids and bucks those grazing on good and medium-quality rangeland in our study but is consistent with those grazing on low-quality rangeland, and while oleic acid (37.8%) is higher than Angora goat kids, stearic acid (12.8%) is lower compared to our results. C16:0 (25%) and C18:1 fatty acids determined by Zurita-Herrera et al. [54] in Murciano-Granadina kids fed on rangeland are higher than the results of kids and bucks, but C(18:0) and C(20:0) is lower than the findings of this study. The results for C18:1 (30.1%–32.9%) of Crillo Cordobes male kids fed under extensive conditions found by Bonvillani et al. [39], are similar to the results of 4-month-old kids, but are lower than the results of 7-month-old bucks in the current study, in addition, while the results for C16:0 (19.6%–21.0%) are consistent with the results of our study, C18:0 (13.5%–16.3%) are lower compared to our study. Capric, lauric, and myristic fatty acids determined by the researchers in male kids are higher than those of our study. The use of different goat breeds in studies, weaning age, feeding differences and fattening duration, rangeland quality, slaughter weight, and age of animals may be the most important reasons for the differences in results. Similarly, Brzostowski et al. [26] stated that as a result of feeding newborn kids with different diets after weaning, the slaughter weight of kids and bucks would increase, so the fatty acid composition can change significantly. They also state that genotype, feeding and breeding methods, age, sex, fat storage type, and anatomical region may also affect the fatty acid composition. According to the results of this study, rangeland quality caused changes in some fatty acids of Angora goat kids and bucks.

Conclusion

This study shows that there are differences in the chemical composition, quality characteristics, and fatty acid composition of the meat of the 4-month-old Angora goat kids and 7-month-old bucks fed on different quality rangeland. According to the current results, the protein content of the meat of kids and bucks increased depending on the rangeland quality. CL and WHC values of meat were positively affected in bucks grazing on good-quality rangeland. The b* yellowness value of meat increased in kids and bucks grazing on low-quality rangeland. The SF value of buck meat grazing on good-quality rangeland was found to be lower and higher on low-quality rangeland. While saturated fatty acid composition increased in kids and bucks grazing on low-quality rangeland, unsaturated fatty acids increased in those grazing on high-quality rangeland. The meat quality of kids and bucks grazing on quality rangelands is high. The decrease in the rangeland quality negatively affects the quality of the meat and its fatty acid properties. It would be beneficial to carry out more studies to better understand the meat quality characteristics of Angora goat kids and bucks grazing on rangelands and compare them with other breeds.

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Approval

The procedures performed on the animals used in the research were carried out in accordance with the Ankara University Animal Experiments Ethics Committee (2016-8-83-430/3642).

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