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Research Article

The Effect of Different Slaughter Weights on the Fattening Performance, Slaughter and Carcass Characteristics of Male Karayaka Lambs

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Abstract: This experiment was carried out to evaluate the effect of different slaughter weights on the fattening performance, slaughter and carcass characteristics of male Karayaka lambs at approximately 4 months of age. Thirty-six lambs, the initial liveweights of which were around 26.5 kg, were divided into 3 groups according to slaughter weight [(Group 1: 35 kg, n = 12), (Group 2: 40 kg, n = 12) and (Group 3: 45 kg, n = 12)] at the beginning of the fattening period. The average daily gain was 203.1, 214.5 and 195.0 g/day, feed conversion efficiency was 7.3, 8.6 and 8.8 kg, and the fattening period was 42.00, 64.67 and 95.08 day in Groups 1-3, respectively. There were significant differences among the groups for average feed conversion efficiency, metabolizable energy, crude protein, and the weight of the head, skin, feet, lung, liver, kidney, internal fat, gastro-intestinal tract and testes ($P < 0.05$, $P < 0.01$). The lean, bone and fat weight, backfat thickness and musculus longissumus dorsi area in the carcass increased with increasing slaughter weight.

In conclusion, the optimal slaughter weight is 40 kg for male Karayaka lambs

Key Words: Karayaka, lambs, slaughter weight, fattening, carcass

Karayaka Erkek Kuzuların Besi Performansı, Kesim ve Karkas Özellikleri Üzerine Farklı Kesim Ağırlıklarının Etkisi

Özet: Bu çalışma 4 aylık yaştaki Karayaka erkek kuzularının besi performansı, kesim ve karkas özellikleri üzerine farklı kesim ağırlığının etkisini değerlendirmek amacıyla gerçekleştirildi. Besi dönemi başında canlı ağırlığı 26,5 kg civarında olan 36 kuzu kesim ağırlıklarına göre üç gruba ayrıldı [(Grup 1: 35 kg, n = 12), (Grup 2: 40 kg, n = 12), (Grup 3: 45 kg, n = 12)]. Gruplarda (Grup 1, 2 ve 3) ortalama günlük ağırlık kazancı sırasıyla, 203,1, 214,5 ve 195,0 gr/gün; yemden yararlanma (kg canlı ağırlık kazancı için tüketilen yem) 7,3, 8,6 ve 8,8 kg; besi süresi 42,00, 64,67 ve 95,08 gün belirlendi. Bir kg canlı ağırlık artışı için yem, enerji, ham protein tüketimi ve baş, deri, ayak, akciğer, karaciğer, böbrek, iç yağ, mide-bağırsak ve testis ağırlık ortalamaları için gruplar arası farklar önemli bulundu ($P < 0,05$, $P < 0,01$). Karkastaki musculus longissumus dorsi kesit alanı, kabuk yağı kalınlığı, et, kemik ve yağ ağırlığının kesim ağırlığının artması ile birlikte arttığı tespit edildi.

Sonuç olarak Karayaka erkek kuzuları için optimum kesim ağırlığı 40 kg olarak söylenebilir.

Anahtar Sözcükler: Karayaka, kuzu, kesim ağırlığı, besi, karkas

Introduction

The Karayaka breed is raised in the Black Sea region and makes up approximately 3% of the sheep population in Turkey. Its average liveweight is around 35-40 kg (1) and it is preferred by consumers because of the taste of its meat (2).

Generally, daily liveweight gain in lambs slaughtered at different weights decreases with increasing slaughter weights (3-6). However, Nakev et al. (7) reported that, in Caucasian lambs fattened until 30, 40 and 50 kg after weaning, daily gain increased with slaughter weights. In cross ram lambs, although daily live gain increased from

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weaning to 55 kg slaughter weight, it later decreased (8). In most studies, it has been shown that lambs consumed more feed per kilogram liveweight gain (3-9).

Carcass weight increases with slaughter weight (5,10). It was reported that dressing percentage usually tends to increase as slaughter weight increases (3-5,8). However, in some studies (7,10,11), it has been reported that dressing percentage was not affected by slaughter weight, but in one study (12) it was found that, as slaughter weight increased, dressing percentage decreased. Nedelchev et al. (9,13) and Aksoy (5) have reported that the percentages and amounts of internal and kidney fat usually increased with slaughter weight, and they showed that there were statistically significant differences between different slaughter weight groups.

In lamb carcasses, high slaughter weight causes an increase in fat percentage (3,5,6,11,14,15), fat thickness (4,8,16) and fat uniformity (17). Gohler (3) has reported that loin eye areas were 11.6, 13.0, 13.3, 14.7 and 15.6 cm^2; lean percentages were 60.3%, 59.2%, 57.3%, 55.4% and 54.7%; and bone percentages were 20.2%, 20.1%, 18.3%, 17.3% and 16.5% in German Mutton × German Mutton Merino cross lambs slaughtered at 30, 35, 40, 45 and 50 kg weights, respectively.

In other studies investigating carcass characteristics at different slaughter weights of lambs it has been found that lean and bone percentages decreased, while slaughter weights increased (5,7,14,15,18,19). Furthermore, rib eye area increased as slaughter weights increased (8,11,17). However, Jeremiah et al. (16) reported that, in ram lambs over the age of 12 months, rib eye area decreased with increasing slaughter weight. Macit (20) reported that rib eye area increased significantly in male Morkaraman lambs slaughtered at 13 weeks of age compared with lambs slaughtered at 15 and 16 weeks of age.

The aim of this study was to determine the fattening performance, slaughter and carcass characteristics of male Karayaka lambs at different slaughter weights, and to help bring about improvements in the profits of sheep breeders.

Materials and Methods

This experiment was conducted at the Application and Research Farm of the Faculty of Veterinary Medicine, Uludağ University in Bursa, Turkey. Thirty-six male fat-tailed Karayaka lambs (all from the same farm) at 4 months of age were used in this study. The lambs were allowed to adapt to the conditions for 15 days. After the adaptation period, the lambs were weighed and randomly assigned to 3 groups according to different slaughter weights [(Group 1; 35 kg, n = 12), (Group 2; 40 kg, n = 12) and (Group 3; 45 kg, n = 12)] at the beginning of the fattening period. The groups were kept in individual boxes and fed individually. Drinking water was supplied ad libitum during the experiment. The lambs had ad libitum access to concentrate (ingredients composition [% of DM]: 45% barley, 34.70% sunflower meal, 16% corn, 2.40% limestone, 0.60% dicalcium phosphate, 0.90% NaCl, 0.10% vitamin and mineral mix, 0.30% ammonium chloride) and alfalfa hay (Tables 1 and 2).

Table 1. Ingredient composition of concentrate feed (on % dry matter basis).

Feedstuffs	%
Barley	45.00
Sunflower meal	34.70
Corn	16.00
Limestone	2.40
Dicalcium phosphate	0.60
NaCl	0.90
Vitamin and mineral mix	0.10
Ammonium chloride	0.30

Table 2. Chemical composition of concentrate feed and alfalfa hay.

Item	Concentrate	Alfalfa hay
Dry matter (%)	88.01	89.93
Crude protein (%)	16.69	17.35
Crude fiber (%)	20.58	22.11
Ether extract (%)	2.19	1.46
Ash (%)	7.49	8.85
Metabolizable energy (kcal/kg DM)	2478.00	2115.00

All lambs were weighed weekly after being fasted for 12 h. The lambs in groups 1-3 were slaughtered when they reached 35, 40 and 45 kg liveweight, respectively. Five lambs in each group were selected randomly to obtain slaughter and carcass characteristics.

The animals were transported to the slaughterhouse and then fasted for 12 h with free access to water and weighed immediately prior to slaughter. The lambs were slaughtered and dressed. The dressed carcass comprised the body after removal of the head, skin, fore and hind feet, tail, kidney, kidney fat and the viscera. The weights of the head, skin, feet, tail, testes, some visceral organs (lungs, liver, heart, spleen and kidneys), kidney fat and intestinal fat were recorded. The gastro-intestinal tract was weighed when it was empty. Carcasses were weighed before chilling and hot dressing percentage was calculated from the ratio of hot carcass weight to slaughter weight. After chilling the carcasses for 24 h at 4 °C, chilled carcass weights were recorded and chilled dressing percentage was calculated from the ratio of chilled carcass weight to slaughter weight. After chilling, the carcasses were dissected along the inside edge of the flank muscle to the distal end of the 13th rib. Then a straight line from the tip of the rib to the apex of angle was made by the junction of the foreleg and shoulder. After cutting the neck from the last cervical vertebra, 2 incisions perpendicular to the axis of carcass were made between the 5th/6th and 12th/13th vertebrae to get a 5-rib shoulder and 7-rib rack. The loin and legs were separated from the anterior edge of the legs and the loin was dissected through an incision between the ilium (1,21,22). The right sides of all carcasses without trimming fat were separated into 8 joints (neck, shoulder, rack, loin, leg, flank, forearm and breast), as described by Calheiros and Neves (23), and totally dissected to determine the bone, fat and lean weights. Carcass data containing loin eye area were obtained by tracing the longissumus dorsi muscle (at 12th rib) upon acetate paper and measured with a planimeter, and back fat thickness at 3 sites was measured. To calculate the whole carcass values, the obtained findings were corrected according to the cutting loss and then multiplied by 2.

The statistical analysis was conducted using SPSS (24). Data on fattening performance, slaughter and carcass characteristics were analyzed by analysis of variance (ANOVA) and Tukey's honestly significant differences tests.

Results

The findings related to fattening performance (initial and final weight, fattening period, liveweight and average daily weight gain), feed intake (alfalfa hay, concentrate) and consumption per kilogram gain (feed, crude protein and metabolizable energy) of male Karayaka lambs slaughtered at 3 different weights (35, 40 and 45 kg) are presented in Table 3. Group 3 lambs exhibited the lowest gain, of 195 g/day, compared to Group 1 and Group 2 lambs, which gained 203.1 and 214.5 g/day, respectively. With increasing slaughter weight (from 40 to 45 kg), average daily gain decreased (in Group 3 = 45 kg). There were no significant differences among the groups in terms of daily weight gain. Fattening periods in the groups were determined to be 22.67 days between 35 and 40 kg, and 30.41 days between 40 and 45 kg (Table 3). Feed consumed per kilogram gain increased with increasing slaughter weight. The difference between Group 1 (7.30) and Group 3 (8.80) was significant ($P < 0.05$) with regard to feed consumption.

The slaughter traits of lambs in the groups are shown in Table 4. The differences among the groups in both hot and chilled carcass weights (15.791, 18.580 and 20.301 kg, and 15.197, 18.072 and 19.742 kg, respectively, in Groups 1-3) were not significant ($P > 0.05$). The weight of visceral organs and tissues increased with increasing slaughter weight. There were significant differences among the groups in terms of weight of head, legs, pelt, lungs, liver, kidneys, internal fat, rumen-intestine and testes and internal fat percentage ($P < 0.05$, $P < 0.001$).

The weight of lean, bone, fat and wholesale cuts (neck, shoulder, forearms, breast, rack, loin, flank, legs); the percentage of lean, bone and fat; back fat thickness and rib eye area are given in Table 5. The proportion of legs, forearms, breast, neck, rack, loin, shoulder and flank in the wholesale cuts (Group 3) were around 32%, 19%, 11%, 10%, 9%, 8%, 5% and 4%, respectively, and legs (32%) had the highest percentage (Table 5). The differences between the groups were significant for breast ($P < 0.01$) and flank percentage ($P < 0.05$) but were not for the percentages of the other wholesale cuts. Carcass back fat thickness and rib eye area increased with slaughter weight. However, there were no significant differences between the slaughter groups. Although the amounts of lean ($P < 0.001$) and bone ($P < 0.01$) in the carcass significantly increased with slaughter weight, the differences for proportion of lean, bone and fat were not significant.

Table 3. Means (± S.E.) for fattening performance and feed intake.

Item	Group 1	Group 2	Group 3	P value
Fattening performance				
Initial weight (kg)	26.49 ± 0.60	26.66 ± 0.69	26.58 ± 0.64	-
Final weight (kg)	34.96 ± 0.14	39.98 ± 0.13	44.96 ± 0.13	-
Fattening period (days)	42.00 ± 2.86	64.67 ± 5.01	95.08 ± 3.28	-
Liveweight gain (kg)	8.47 ± 0.63	13.47 ± 0.72	18.40 ± 0.68	-
Average daily gain (g/day)	203.10 ± 0.0	214.50 ± 0.00	195.00 ± 0.00	N.S.
Feed intake (kg)				
Alfalfa hay	28.73 ± 2.23	45.80 ± 3.57	58.31 ± 1.90	-
Concentrate	32.17 ± 2.46	70.13 ± 7.63	102.37 ± 5.08	-
Total	60.89 ± 4.08	115.93 ± 10.58	160.67 ± 5.70	-
Consumption for per kg gain				
Feed (kg)	7.30 b ± 0.31	8.60 ab ± 0.49	8.80 a ± 0.32	*
Crude protein (g)	124.11 b ± 5.24	145.84 ab ± 8.30	148.93 a ± 5.38	*
Metabolizable energy (kcal)	9693.6 b ± 654.4	12978.5 b ± 1055.0	13963.8 a ± 559.3	***

S.E., standard error; N.S., not significant; Means with different letters in the same rows are significantly different.
* $P < 0.05$; *** $P < 0.001$.

Discussion

The findings related to fattening performance (initial and final weight, fattening period, liveweight and average daily gain), feed intake (alfalfa hay, concentrate) and consumption per kilogram gain (feed, crude protein and metabolizable energy) of male Karayaka lambs slaughtered at 3 different weights (35, 40 and 45 kg) are presented in Table 3.

The average daily gains in Group 1 and Group 2 (203.1 and 214.5 g/day, respectively) were higher than that in Group 3 (195 g/day). When the slaughter weight increased from 40 to 45 kg, average daily gain decreased (in Group 3 = 45 kg). There were no significant differences among the groups for daily weight gain. Fattening period in the groups was determined to be 22.67 days between 35 and 40 kg, and 30.41 days between 40 and 45 kg (Table 3). Feed consumed per kilogram gain increased with increasing slaughter weight. The difference between Group 1 (7.30) and Group 3 (8.80) was significant ($P < 0.05$). In this study, the results showed that daily gains of Karayaka male lambs decreased over 40 kg slaughter weight. However, feed consumed per kilogram gain increased with increasing slaughter weight. These results are supported by the findings reported by Sents et al. (8), Chant (6), Beerwinkle et al. (4), Gohler (3), Aksoy (5) and Nedelchev et al. (9), but are contrary to those published by Nakev et al. (7). When we compared the fattening period among the groups, the period between 40 and 45 kg (30.41 days) was longer than that between 35 and 40 kg (22.67 days). Therefore, fattening over 40 kg slaughter weight for male Karayaka lambs can cause an increase in the costs of production.

The differences among the groups in both hot and chilled carcass weights were not significant ($P > 0.05$). These results are in agreement with the findings given by Nakev et al. (7), Al-Jaryan et al. (10) and Boikowski (11).

The average weights of head, legs, pelt, tail and internal organs were the highest in lambs slaughtered at 45 kg (Group 3). When the slaughter weight increased from 35 to 40 kg, chilled carcass weight increased 2875 g (57.5% of 5 kg liveweight gain). However, when the slaughter weight increased from 40 to 45 kg, chilled carcass weight increased 1670 g (33.4% of 5 kg liveweight gain). These findings showed that, when the slaughter weight was over 40 kg, an increase in liveweight gain is related to increases in the weights of head, legs, pelt, internal fat, tail fat and internal organs rather than in carcass weight.

Table 4. Means (± S.E.) carcass characteristics for different slaughter weights.

Traits	Group 1	Group 2	Group 3	P value
Carcass weight (kg)				
Slaughter weight	34.958 ± 0.489	39.983 ± 0.465	44.975 ± 0.435	-
Hot carcass weight	15.791 ± 0.261	18.580 ± 0.382	20.301 ± 0.342	-
Chilled carcass weight	15.197 ± 0.234	18.072 ± 0.412	19.742 ± 0.270	-
Hot dressing percentage (%)	45.516 ± 0.707	45.913 ± 0.923	45.354 ± 0.732	N.S.
Chilled dressing percentage (%)	43.805 ± 0.666	44.660 ± 1.013	44.106 ± 0.574	N.S.
Offal items (kg)				
Head weight	2.121 c ± 0.058	2.467 b ± 0.088	2.872 a ± 0.059	***
4 feet weight	0.824 b ± 0.043	0.964 ab ± 0.048	0.991 a ± 0.012	*
Skin weight	4.654 b ± 0.313	5.231 b ± 0.217	6.539 a ± 0.207	***
Tail weight	0.259 ± 0.015	0.361 ± 0.059	0.488 ± 0.087	N.S.
Lung weight	0.547 b ± 0.080	0.723 a ± 0.037	0.759 a ± 0.034	**
Liver weight	0.660 c ± 0.017	0.826 b ± 0.020	0.907 a ± 0.018	***
Heart weight	0.258 ± 0.009	0.248 ± 0.025	0.388 ± 0.148	N.S.
Spleen weight	0.108 ± 0.033	0.107 ± 0.022	0.130 ± 0.022	N.S.
Kidney weight	0.111 b ± 0.006	0.132 ab ± 0.003	0.136 a ± 0.008	*
Kidney fat weight	0.195 ± 0.036	0.199 ± 0.027	0.269 ± 0.028	N.S.
Internal fat weight	0.331 b ± 0.062	0.410 b ± 0.054	0.747 a ± 0.066	***
Internal fat percentage (%)	2.122 b ± 0.423	2.192 b ± 0.264	3.683 a ± 0.342	*
Gastro-intestinal tract weight	2.963 b ± 0.142	3.560 a ± 0.128	4.107 a ± 0.149	***
Testes weight	0.259 b ± 0.039	0.410 ab ± 0.014	0.399 a ± 0.032	*

Means with different letters in the same rows are significantly different.* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

In the present study, a significant increase was observed in the weight of shoulder, forearms, breast, rack, loin, flank and legs (but not neck) with increasing slaughter weight. In spite of this, except for breast and flank percentages, the percentages were insignificant at different slaughter weights. These results showed that increases in breast and flank percentages were continuing to increase until slaughter weight reached 45 kg.

Macit (20) reported that, when the slaughter weight increases, the rib eye area expands and our results are in agreement with this result. The proportion of fat in the carcass increased, while those of bone and lean decreased with increasing slaughter weight. Similar results were reported by Tahir et al. (18).

The differences observed for lean amount in all 3 groups showed that it continued to increase with increasing slaughter weight. However, a similar result was not observed for bone amount after 40 kg slaughter weight. Lean amount increased 2197 g (43.94% of 5 kg liveweight gain) when the slaughter weight increased from 35 to 40 kg, but it increased 968 g (19.36% of 5 kg liveweight gain) when the slaughter weight increased from 40 to 45 kg. These findings showed that bone weight and especially fat amount increased instead of lean amount in carcass of lambs slaughtered between 40 and 45 kg liveweight. These results suggested that carcass weight decreased when the slaughter weight was over 40 kg. Moreover, it showed that lean amount in the carcass decreased significantly. Most studies (3,5-7,10,11,14,15,19,20), which support the results of the current study, have reported that lean and bone amount, back fat thickness and rib eye area increased while lamb slaughter weight was increasing.

In conclusion, the findings obtained in the present study showed that daily gain, feed conversion rate, carcass weight and lean percentage decreased and fattening period extended but fat weight increased when the slaughter weight was over 40 kg. Therefore, the optimal slaughter weight is 40 kg for male Karayaka lambs.

Table 5. Means (± S.E.) carcass merits for different slaughter weights.

Traits	Group 1	Group 2	Group 3	P value
Chilled carcass weight (kg)	15.197 ± 0.234	18.072 ± 0.412	19.742 ± 0.270	-
Wholesale cuts (kg)				
Neck weight	1.588 ± 0.175	1.856 ± 0.245	1.878 ± 0.146	N.S.
Neck percentage (%)	10.468 ± 1.277	10.236 ± 0.914	9.505 ± 0.509	N.S.
Shoulder weight	0.860 b ± 0.079	0.964 ab ± 0.080	1.058 a ± 0.074	**
Shoulder percentage (%)	5.652 ± 0.402	5.340 ± 0.412	5.354 ± 0.269	N.S.
Forearms weight	2.880 b ± 0.155	3.537 a ± 0.109	3.746 a ± 0.206	***
Forearms percentage (%)	18.963 ± 1.127	19.590 ± 0.410	18.988 ± 1.208	N.S.
Breast weight	1.741 b ± 0.134	1.825 b ± 0.216	2.390 a ± 0.162	***
Breast percentage (%)	11.453 ab ± 0.706	10.103 a ± 1.144	12.096 a ± 0.521	**
Rack weight	1.392 b ± 0.113	1.722 a ± 0.119	1.818 a ± 1.650	***
Rack percentage (%)	9.163 ± 0.758	9.531 ± 0.487	9.213 ± 0.841	N.S.
Loin weight	1.165 b ± 0.124	1.565 a ± 0.227	1.571 a ± 0.574	**
Loin percentage (%)	7.653 ± 0.597	8.634 ± 0.946	7.957 ± 0.162	N.S.
Flank weight	0.597 b ± 0.070	0.697 b ± 0.125	0.939 a ± 0.100	***
Flank percentage (%)	3.933 b ± 0.467	3.841 b ± 0.530	4.748 a ± 0.376	*
Leg weight	5.015 c ± 0.261	5.941 b ± 0.148	6.384 a ± 0.193	***
Leg percentage (%)	32.980 ± 0.657	32.920 ± 1.322	32.348 ± 0.889	N.S.
Lean, bone and fat component (kg)				
Lean weight	9.882 c ± 0.487	12.079 b ± 0.382	13.047 a ± 0.254	***
Lean percentage (%)	65.001 ± 1.095	66.896 ± 1.601	66.112 ± 1.116	N.S.
Bone weight	2.835 b ± 0.277	3.199 a ± 0.182	3.360 a ± 0.154	**
Bone percentage (%)	18.699 ± 2.245	17.766 ± 1.720	17.042 ± 1.087	N.S.
Fat weight	2.480 ± 0.280	2.794 ± 0.719	3.334 ± 0.498	N.S.
Fat percentage (%)	16.300 ± 1.535	15.338 ± 3.285	16.847 ± 2.104	N.S.
Back fat thickness (cm)	0.390 ± 0.074	0.550 ± 0.206	0.570 ± 0.130	N.S.
Rib eye area (cm2)	10.048 ± 1.694	11.158 ± 1.027	12.486 ± 2.086	N.S.

Means with different letters in the same rows are significantly different.* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

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