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Short Communication / *Kısa Bilimsel Çalışma*

Slaughter and carcass characteristics of Kivircik lambs in different rearing seasons

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Abstract: The aim of this study was to determine the slaughter and carcass characteristics of Kivircik lambs reared in different seasons. A Total of 36 Kivircik male lambs, which were reared in different seasons, were used in the study; autumn rearing (AR, n= 12 lambs), spring-summer rearing (SSR, n= 12 lambs), winter rearing (WR, n= 12 lambs). All the lambs in a specific rearing season were slaughtered at approximately 134 days old. Pre-slaughter live weight, hot carcass weight and real dressing percentage for WR, SSR and AR groups were 27.97, 20.65, and 21.70 kg; 12.94, 7.83, and 8.87 kg, and 55.15, 50.25, and 50.05%, respectively ($P < 0.001$). WR lambs had significantly higher carcass and hind limb compactness score as well as ribs percentage than SSR and AR lambs ($P < 0.001$). The results indicated that lambs from WR group had better carcass characteristics than lambs from AR and SSR groups.
Keywords: Indoor lambs, lamb finishing, pasture lambs, seasonal effect.

Farklı büyüme mevsimlerinde Kıvırcık ırkı kuzuların kesim ve karkas özellikleri

Özet: Bu projede, mevsime bağlı kuzu üretim sistemlerinde büyütülen Kıvırcık ırkı kasaplık kuzuların kesim ve karkas özelliklerinin belirlenmesi amaçlanmıştır. Çalışmada farklı mevsimlerde büyütülen toplam 36 baş Kıvırcık ırkı erkek kuzu [sonbahar (AR, n=12); ilkbahar-yaz (SSR, n=12); kış (WR, n=12)] kullanılmıştır. WR, SSR ve AR grubu kuzulara ait kesim öncesi canlı ağırlık, sıcak karkas ağırlığı ve gerçek karkas randımanı ortalamaları sırasıyla 27,97; 20,65 ve 21,70 kg; 12,94; 7,83 ve 8,87 kg; %55,15; 50,25 ve 50,05 olarak tespit edilmiştir ($P < 0,001$). WR grubu kuzuların karkas kompaktlığı, but kompaktlığı ve kaburga oranı bakımından SSR ve AR grubu kuzulara kıyasla daha yüksek ortalamalara sahip oldukları belirlenmiştir ($P < 0,001$). Çalışma bulguları WR grubu kuzuların SSR ve AR grubu kuzulara kıyasla daha iyi karkas özelliklerine sahip olduğu tespit edilmiştir.
Anahtar sözcükler: Ağıl besisi, kuzu besisi, mera kuzusu, mevsim etkisi.

Consumers' growing interest in naturally reared lambs, which grazed on pasture, was observed in recent years (10). In traditional sheep breeding program in Marmara region, matings usually take place between June-August months, and therefore lambing occurs during winter. Because of the unsuitability of pasture areas for lambs' grazing, feeding lambs with concentrate feeds and their mothers' milk on sheepfold during winter is the most common lamb production system. However, conditions of pasture may vary due to season. Some farmers intend to supply quality lambs to market throughout the year, producing lambs out of the breeding season by using the advantage of the pasture (2). They use pastures to provide lambs' nutritional needs.

The feeding systems of animals may change according to the rearing season. Also, we know that husbandry conditions and feeding systems influence the carcass quality characteristics of lambs (10). Carcass weight (14), fatness level and dressing percentage of the lambs (8, 10) fed with concentrate feeds were reported to be higher than grazed lambs. This study was produced from a project, which investigated the effect of rearing season (spring-summer, winter and autumn) on slaughter characteristics, carcass and meat quality properties in male Kivircik lambs. This part includes certain slaughter and carcass characteristics results of the main project.

Animal handling procedures of the study were approved by the Ethics Committee of İstanbul University

(Approval no: 2015/05). The material was formed by 36 male Kivircik lambs which were born in winter (n = 12 lambs), spring-summer (n = 12 lambs) and autumn (n = 12 lambs) in the research farm of İstanbul University. At the beginning of the natural breeding season, the herd were separated into three groups to organize the synchronizations of ewes in each mating period (May, October, and February). Mean values of daily minimum ambient temperature, maximum ambient temperature and rainfall, which calculated by averaging daily data over the study, were 7.2 ℃, 12.5 ℃ and 1.9 mm in the winter season, 15.3 ℃, 23.4 ℃ and 1.1 mm in spring-summer season, 18.2 ℃, 24.9 ℃ and 1.1 mm in the autumn season, respectively. Winter rearing (WR) lambs received concentrate feed (87.7% dry matter, 17.15% crude protein, 11.10 MJ/kg ME; 500 g / per animal / day) in the sheepfold after the age of 15 days until slaughter age. These lambs were also allowed to suckle their dams throughout the study. Lambs reared in spring-summer (SSR) and autumn (AR) seasons received the same nutrition programme as WR lambs until the age of two months, after this age these lambs grazed at the natural pasture in the day time with their dams. While SSR lambs grazed summer pasture, AR lambs were taken to autumn pasture. Lambs in both groups received concentrate feed when they returned from the pasture and after being separated from their dams. Alfalfa hay, which contained 87.8% dry matter, 12.88% crude protein, 7.72 MJ/kg ME, was given to all sub-groups with ad libitum access after two weeks of age in the sheepfold. Detailed descriptions of the feeds used in the present study were given in Yalcintan et al. (15). The pasture characteristics were widely described in Ekiz et al. (8).

All the lambs in a specific rearing season were slaughtered at approximately 134 days old in the same day at the experimental slaughterhouse of İstanbul University Faculty of Veterinary Medicine. Hot carcasses were weighted after the elimination of the non-carcass components (skin, head, feet, trachea and lungs, spleen, heart, liver, and gastro-intestinal tract) and then chilled for 24 h at 4 ºC. Hot carcasses included kidney and kidney knob and channel fat (KKCF). We estimated the commercial dressing percentage using pre-slaughter live weight and real dressing percentage with empty body weight. After kept for 24 h at 4 ºC, firstly the cold carcasses were divided into two halves, then left halves were divided into five parts including neck, shoulder, ribs, flank, and hind limb (6).

Lengths of carcass and leg, widths of buttock and carcass, circumferences of buttock and chest were measured on whole carcasses, while lengths of internal carcass and hind limb, and thoracic depth were measured from half carcasses (3, 9, 11). Hind limb compactness, carcass compactness and chest roundness index were calculated according to Ekiz et al. (9). One-way ANOVA and Duncan's multiple range tests in SPSS 13 programme were used to evaluate the differences among rearing seasons.

Differences among the season groups in terms of pre-slaughter weight and hot carcass weight were found significant for the lambs slaughtered at 134 days of age (Table 1). A higher pre-slaughter weight of the lambs from

Table 1. Means ± standard errors for slaughtering characteristics of lambs reared in different seasons

Characteristics	WR	SSR	AR	*P*-value
Pre-slaughter live weight, kg	27.97^{a}±1.38	20.65^{b}±0.58	21.70^{b}±1.00	<0.001
Hot carcass weight, kg	12.94^{a}±0.65	7.83^{b}±0.29	8.87^{b}±0.56	<0.001
Commercial dressing [1], %	46.29^{a}±0.80	37.83^{c}±0.63	40.56^{b}±0.80	<0.001
Real dressing [2], %	55.15^{a}±0.55	50.25^{b}±0.44	50.05^{b}±0.72	<0.001
Head, %	6.96^{b}±0.11	8.32^{a}±0.30	7.40^{b}±0.14	<0.001
Feet, %	3.16^{b}±0.08	3.87^{a}±0.05	3.31^{b}±0.09	<0.001
Skin, %	11.45±0.47	11.07±0.62	12.07±0.18	0.313
Lungs and trachea, %	1.74^{b}±0.05	2.23^{a}±0.09	2.12^{a}±0.10	<0.001
Liver, %	1.94^{b}±0.05	2.37^{a}±0.07	2.23^{a}±0.08	<0.001
Heart, %	0.53±0.02	0.61±0.02	0.57±0.05	0.220
Spleen, %	0.24^{b}±0.01	0.38^{a}±0.05	0.27^{b}±0.01	0.004
Omental and mesenteric fat, %	0.82^{a}±0.09	0.07^{b}±0.01	0.73^{a}±0.10	<0.001
Stomachs, %	19.42^{b}±1.48	30.15^{a}±2.31	22.28^{b}±0.87	<0.001
Empty stomachs, %	3.75^{b}±0.15	4.97^{a}±0.24	4.58^{a}±0.18	<0.001
Intestine, %	9.48^{b}±0.33	14.03^{a}±1.63	12.44^{a}±0.31	0.008
Empty intestine, %	5.79^{b}±0.22	6.10^{b}±0.11	6.59^{a}±0.15	0.007
Gastro-intestinal tract, kg	4.59±0.47	5.10±0.24	4.09±0.13	0.095

[a, b, c] Means in the same line with different superscripts are significantly different.
[1] Commercial dressing: hot carcass dressing based on pre-slaughter live weight;
[2] Real dressing: hot carcass dressing based on empty body weight.
WR: Winter rearing, SSR: Spring-summer rearing, AR: Autumn rearing.

the WR group caused higher hot carcass weights for these lambs compared to lambs from the SSR and AR groups. Previously, some researchers have reported an increase in the hot carcass weight in parallel to an increase in the pre-slaughter weight (1, 13). AR and WR groups had higher mean values regarding the omental and mesenteric fat percentages than the SSR group. This difference was probably due to the high energy intake of lambs fed with concentrated feed (4). Ekiz et al. (8), who were investigating the effect of rearing systems on carcass quality, determined that lambs fed with concentrates at sheepfold had higher omental and mesenteric fat percentages than weaned pasture lambs. SSR lambs had lower omental and mesenteric fat percentages than AR and WR groups, which could be linked by the heat stress for the SSR lambs due to grazing on the summer pasture and decreased feed intake. In our previous study (15), which was conducted similar to the current study, we also found lower carcass fatness score for spring-summer rearing lambs than winter and autumn rearing lambs, while winter rearing lambs had the highest backfat thickness in that study.

Winter rearing lambs which were kept with their dams during the rearing period presented lower lung and trachea, liver, intestine, and empty stomach percentages. Supporting the findings of this study Karim et al. (12) determined a higher liver percentage for the lambs fed on pasture than the lambs fed in sheepfold. Authors explained this difference with possible consumption of harmful vegetation which leads to liver growth caused by detoxification. On the other hand, Majdoub-Mathlouthi et al. (13) reported decreased liver percentage in parallel to the increased pre-slaughter weight. Percentage of the gastrointestinal tract might be associated with several factors, such as type of feed (pasture, concentrate), pre-slaughter age/weight of animals (8, 12, 13, 14). It has been suggested that digestive tract development is usually faster in animals grazed on pasture (8, 13). In the current study, there were no significant differences between season groups in terms of animal age. As expected, SSR and AR lambs had higher empty stomach percentage than WR lambs. This could be related to the higher development of digestive tract in pasture lambs. Supporting our results Ekiz et al. (8) reported a higher empty stomach percentage for the pasture-based lambs than lambs fed with concentrate. Moreover, lower pre-slaughter weights of SSR and AR lambs could be another explanation for higher percentages of empty stomachs.

Dressing percentage is describing the ratio between carcass weight and pre-slaughter live weight of the animal and depends on many factors such as age/weight at slaughter, husbandry system, breed and gender, feeding system, and whether it is calculated on the bases of empty or full body weight, which can be influenced by gastrointestinal content (7). As expected, WR lambs which were fed concentrate and reared sheepfold had higher commercial and real dressing percentage compared to SSR and AR lambs. However, these results cannot be explained by the only higher energy content of the diet. In addition, it should be considered that SSR and AR lambs which were grazed on pasture had higher lungs and trachea, liver and empty stomach percentages. Similarly, Priolo et al. (14) also determined a higher dressing percentage for lambs fed with concentrates in the sheepfold, even though slaughtering the pasture and sheepfold lambs at similar weights. The researchers explained this result by the lower intestinal tract content of sheepfold based lambs. Ekiz et al. (8) explained a lower dressing percentage of pasture lambs compared to concentrate fed lambs by a higher percentage of non-carcass components in the pasture lambs.

SSR lambs showed the highest values for the shoulder, flank and neck proportion, while WR lambs had the highest values for the ribs percentage (Table 2). SSR lambs presented lower KKCF percentage than AR and WR lambs ($P < 0.001$). Ekiz et al. (8) also found higher shoulder proportion for lambs grazed at pasture than lambs fed with concentrates at sheepfold. Lambs from WR group showed higher mean values than SSR and AR lambs in terms of internal carcass length, buttock width and circumference, carcass width, thoracic depth, and chest circumference (Table 2). In contrast to this study, Carrasco et al. (5) for Churra Tensina lambs and Ekiz et al. (10) for Kivircik lambs reported higher mean values for longitudinal carcass measurements (internal carcass length and hind limb length) for the grazed lambs than lambs fed with concentrates. The variation between researches might be explained by slaughtering the lambs from pasture and concentrate groups at different ages in those studies. Ekiz et al. (10) reported that pasture lambs had higher lengths of hind limb and internal carcass among the four different rearing groups, where lambs were slaughtered at similar weights due to fact that pasture lambs reached the target weight at older ages. Supporting our findings, Abdullah and Qudsieh (1) reported an increase in hind limb compactness and carcass measurements in parallel to the increase in the carcass weight. WR lambs had higher values for the carcass and hind limb compactness indices than lambs from AR and SSR groups which could be attributed to the high pre-slaughter weight for WR lambs. It has been determined that characteristics which have considerable economic importance, such as pre-slaughter live weight, dressing percentage, carcass compactness and hind limb compactness were higher in WR lambs compared to AR and SRR lambs. The results indicated that lambs from WR group had better slaughter and carcass characteristics than lambs from AR and SSR groups.

Table 2. Means ± standard errors for proportion of carcass cuts and certain carcass measurements of lambs reared in different seasons

Characteristics	WR	SSR	AR	*P*-value
Shoulder, %	18.90^{b}±0.36	20.30^{a}±0.21	19.29^{b}±0.31	0.007
Flank, %	9.14^{c}±0.30	11.64^{a}±0.38	10.62^{b}±0.19	<0.001
Neck, %	8.25^{b}±0.21	9.53^{a}±0.29	8.21^{b}±0.19	<0.001
Ribs, %	27.86^{a}±0.50	23.91^{c}±0.39	25.78^{b}±0.43	<0.001
Thoracic region, %	18.64^{a}±0.41	16.68^{b}±0.27	17.07^{b}±0.32	0.001
Lumbar region, %	9.25^{a}±0.22	7.22^{b}±0.27	8.71^{a}±0.27	<0.001
Hind limb, %	33.27±0.49	33.00±0.23	33.69±0.34	0.410
Tail, %	0.99^{a}±0.08	0.47^{c}±0.05	0.77^{b}±0.07	<0.001
Kidney, %	0.65^{b}±0.02	0.92^{a}±0.03	0.89^{a}±0.05	<0.001
KKCF ^{g}, %	0.95^{a}±0.12	0.24^{b}±0.03	0.75^{a}±0.09	<0.001
Carcass measurements				
Carcass length, cm	63.55±2.60	62.13±0.81	60.88±0.88	0.526
Internal carcass length, cm	56.78^{a}±0.87	49.18^{c}±0.65	52.48^{b}±0.65	<0.001
Leg length, cm	19.93^{a}±0.26	19.72^{a}±0.47	18.57^{b}±0.17	0.012
Hind limb length, cm	26.15±0.46	26.88±0.41	25.65±0.30	0.104
Buttock width, cm	16.25^{a}±0.33	13.90^{b}±0.30	14.34^{b}±0.41	<0.001
Buttock circumference, cm	51.88^{a}±0.99	41.87^{b}±1.05	43.76^{b}±0.94	<0.001
Carcass width, cm	19.43^{a}±0.43	15.14^{c}±0.40	16.99^{b}±0.54	<0.001
Thoracic depth, cm	23.47^{a}±0.47	20.76^{b}±0.30	21.30^{b}±0.44	<0.001
Chest circumference, cm	67.53^{a}±1.07	58.48^{b}±0.57	58.16^{b}±1.08	<0.001
Carcass compactness, g/cm	221.44^{a}±9.60	152.17^{b}±4.17	163.34^{b}±8.75	<0.001
Hind limb compactness, g/cm	80.03^{a}±3.72	47.58^{b}±1.88	54.55^{b}±5.96	<0.001
Chest roundness index	0.83^{a}±0.02	0.73^{b}±0.02	0.80^{a}±0.02	0.001

$^{a, b, c}$ Means in the same line with different superscripts are significantly different.
WR: Winter rearing, SSR: Spring-summer rearing, AR: Autumn rearing.

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Ethical Statement

This study was approved by the İstanbul University Animal Research Ethics Committee of (Approval no: 2015/05)

Conflict of Interest

The authors declared that there is no conflict of interest.

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