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In the name of Allah

MEAT FROM CULLED OLD EWES OF TWO FAT-TAILED IRANIAN BREEDS. II-MEAT, SUBCUTANEOUS FAT, AND BONE IN THE WHOLESALE CUTS[1]

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ABSTRACT

One hundred and one 4 to 8 year old ewes of two fat-tailed Iranian breeds (Karakul and Naeini) were fattened for 40, 50, or 60 days and slaughtered. The ewes had been culled primarily for age and/or poor condition. The chilled carcasses were dissected according to the routine procedure in Iran into six wholesale cuts, including leg, shoulder, back (loin+fore-rib), flank+brisket, neck, and fat-tail. Meat, subcutaneous fat, and bone were separated in all the cuts, except for the flank+brisket in which only the bone was separated from the meat plus fat. The fat-tail was composed almost entirely of fat.

Karakul ewes has significantly heavier wholesale cuts compared to the Naeinis, except for the fat-tail which was

بنام خدا

تولید گوشت از میشهای حذفی پیر دو نژاد دنبه‌دار ایرانی ــ ۲ ــ گوشت، چربی سطحی و استخوان در قطعات لاشه

عبدالحسین فرید نائینی، جمشید ایزدی‌فرد، محمدعلی ادریس و محمود مکارچیان
بترتیب مربی سابق، دستیار فنی، مربی و استاد سابق بخش دامپروری دانشگاه شیراز

خلاصه

تعداد صدویک راس میش ۴ تا ۸ ساله از دو نژاد دنبه‌دار ایرانی (قره‌گل و نائینی) به مدتهای ۴۰، ۵۰ و ۶۰ روز پروار و سپس کشتار شدند. میشها بخاطر پیری یا لاغری از گله حذف شده بودند. لاشه‌های سرد به روش برش ایرانی به شش قسمت بریده شدند که قطعات شامل ران، دست، راسته، پیش سینه + قلوه‌گاه، گردن و دنبه بودند. گوشت، چربی سطحی و استخوان تمامی قسمتها از یکدیگر جدا شدند بجز قسمت پیش سینه و قلوه‌گاه که در آن تنها استخوان از گوشت و چربی جدا گردید. تقریباً تمامی دنبه از چربی تشکیل شده بود.

میشهای قره‌گل بطرز مشخصی از نظر کلیه قسمتهای لاشه نسبت به میشهای نائینی برتری داشتند بجز دنبه که اندازه آن تقریباً در دو نژاد مشابه بود. میانگین درصد قطعات مختلف نسبت به وزن لاشه سرد بدین شرح بود: ران ۲۸/۵، دست ۱۶/۰، راسته ۱۶/۸، پیش سینه و قلوه‌گاه ۲۱/۸ و گردن ۵/۵ که بین دو نژاد اختلاف مشخصی مشاهده نشد. در میشهای نائینی دنبه درصد بیشتری از لاشه سرد را در مقایسه با نژاد قره‌گل (۱۱/۸ در مقابل ۸/۸ درصد) تشکیل داد. درصد

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almost similar in the two breeds. The means of wholesale cuts as percentages of the chilled carcass weight were: leg 28.5, shoulder 16.0, back 16.8, flank+brisket 21.8, and neck 5.5, with no difference between the breeds. The fat-tail comprised a higher percentage of the chilled carcass in the Naeini than in the Karakul ewes (11.8 vs. 8.8%). Percent cut weights were similar among the age groups.

The weights of meat and bone were higher in Karakul as compared to Naeini in all the cuts, with no difference between breeds in their subcutaneous fat content, except for the back in which Karakul had a significantly higher amount of fat. Adjusted for cut weight, Karakul had a higher percent meat in the shoulder and neck, and a higher percent bone in the leg and flank+brisket, while Naeini had a higher percent subcutaneous fat in all the cuts except in the back. Age of the ewes had very little effect on the percentage of each component. Percent meat and bone tended to decline while percent subcutaneous fat increased significantly in the leg and shoulder as feedlot period increased.

قطعات درگروههای سنی یکسان بود.

درتمام قطعات، وزن گوشت واستخوان برای نژاد قره‌گل بیشتر از نائینی بود. چربی سطحی قطعات بین دونژاد اختلافی نشان نداد ولی چربی راسته درنژاد قره‌گل بطرز مشخصی بیشتر بود. براساس وزن قطعه، قره‌گل درصد گوشت بیشتری در قسمتهای دست، گردن ودرصد بیشتری استخوان ران وپیش سینه+ قلوه‌گاه داشت، درحالیکه نائینی درصد بیشتری چربی سطحی درکلیه قطعات بجز راسته داشت. سن میش اثر بسیار کمی بر درصد هر قسمت داشت. با افزایش دوره پرواری، درصد گوشت واستخوان کاهش یافت، درحالیکه درصد چربی سطحی درقسمت ران و دست بطرز مشخصی افزایش یافت.

INTRODUCTION

Although sheep have been traditionally the major source of red meat in Iran, information on the carcass characteristics of the native sheep is indeed scarce. One of the major goals of sheep husbandry is the production of a lean carcass with an optimum level of fat deposition. The value of a carcass or a wholesale cut should be determined by its composition, which is the proportion of lean meat, fat and bone, and the meat quality. The weight of bone and muscle in each joint relative to the total carcass, bone and muscle, respectively, seems to be more or less constant in different breeds of sheep (10, 11, 19) and cattle (2, 3, 5), and to some extent even in different species of mammals (2). This is because each individual bone or muscle has evolved as a result of a defined biological function (2). The rate of fat deposition in each depot, on the other hand, differs during growth and fattening stages (2, 4) resulting in changes in the relative weight of joints and percent composition of each joint. Factors such as breed, age, sex, level of nutrition, and slaughter weight affect carcass composition mainly through their effect on fat deposition (2, 4). Although much work has been done on the effects of genetic and environmental factors on carcass composition in non-fat-tailed breeds of sheep, such studies on fat-tailed breeds, in general, and cull ewes which comprise a major source of red meat in Iran, in particular, is very limited.

The objective of this study was to determine the effect of age and length of stay in the feedlot on the relative weight and composition of wholesale cuts in two fat-tailed breeds of sheep differing in mature size.

MATERIALS AND METHODS

One hundred and one carcasses of 4 to 8 year old ewes were available for this study. The ewes belonged to two fat-tailed Iranian sheep breeds, Naeini and Karakul, an early maturing-small size and a medium size breed, respectively (6). They were culled from the breeding flock prior to the 1976 mating season, mainly due to old age, irregular teeth and/or poor condition, a routine practice by the local sheep producers. The ewes were put in the feedlot and were slaughtered at random within each breed after 40, 50, or 60 days in feedlot. The performance of the ewes in the feedlot and some of their carcass characteristics have been described previously (7). The kidneys and kidney fat were removed from the warm carcass. The metacarpal bone (shank bone) and the metatarsal bone (hind shank bone) were also separated from the warm carcass.

The carcasses were cut into right and left sides, and were chilled at -1 to +3°C. The chilled carcasses were weighed and were sawn between the 12th and 13th ribs, perpendicular to the back, separating the foresaddle and hindsaddle.

Each of these parts was then divided down the back-bone and was dissected into the commercial wholesale cuts traditionally applied in Iran. The commercial cuts, which with a few exceptions have clear anatomical boundaries, are briefly described as follows:

The foresaddel: The neck was separated by sawing the vertebral column at the junction of the 7th cervical and the first thoracic vertebrae. The shoulder was cut by separating the fore-limb from the rib cage through the natural seam. The round cut extended to the extremity of the blade cartilage (scapular cartilage). The brisket was separated from the fore-rib by sawing off the rib bones in a straight line starting approximately 2 cm from the eye muscle and continuing parallel to the back of the rack.

The hindsaddle: The fat-tail was removed by a round knife cut leaving no or one caudal vertebrae (tail-bone) in this cut. The leg was separated from the backbone at the junction of the last lumbar and the first sacral vertebrae, continuing the cut forward to separate the flank without removing any of the leg muscles. The flank was separated from the loin by sawing off the 13th rib bone, starting 2 cm from the eye muscle, and continuing in a straight line parallel to the back of the loin. The loin and the fore-rib were added together and will be referred to as the back in this article.

The cuts were weighed to the nearest 5 g, labelled and stored at -15°C until dissected. The cuts were selected at random for dissection each day and allowed to thaw at room temperature for approximately 18 hours when they were reweighed. The subcutaneous fat was separated as closely to the muscle as possible and then the bone and non-edible parts were separated. The remainder was classified as the meat component. The non-edible parts of the cuts were weighed with the bone, except in the back and neck. The flank+brisket was dissected to meat+fat and bone (rib bones plus cartilages). The weights of bone and meat in the fat-tail were negligible because this cut did not include tail bone in most of the cases, and the cut was considered as pure fat. Each of the components was weighed to the nearest 2 g.

The average of wholesale cuts and the average of the components in the right and the left side of each carcass were used for statistical analysis. Data were analyzed by the least-squares procedure using LSML 76 computer package (9). The breed, age of ewe, duration of feedlot stay, and their two-way interactions, all of which were considered to be fixed effects, were used in the model. The 7 and 8 year old ewes were grouped together, because of the limited number of observations in the latter age group.

RESULTS AND DISCUSSION

Wholesale Cuts

The least-squares means of the wholesale cut weights (average of both sides of the carcass) are shown in Table 1, and mean weight of each cut as a percentage of the chilled carcass is shown in Table 2. All the cuts of the Karakul ewes, except the fat-tail, were significantly ($P < .01$) heavier than those of the Naeini ewes. Such differences in cut weights were expected, as the average slaughter weights of the Naeini and Karakul ewes were 37.3 and 48.4 kg, respectively (7). There was no significant difference between Karakul and the Naeini ewes in the cut weights when expressed as a percentage of chilled carcass weight, except for the fat-tail which was significantly higher in the small-sized Naeini breed.

The age of ewe had a significant effect on the weight of all the cuts, except on the fat-tail. Weight of the cuts increased with age, resulting in a significant difference between the four-year old and seven- and eight-year old ewes in favor of the latter group. The cut weights as

Table 1. Least squares means for differences between means of wholesale cuts from half carcasses (kg)[†].

Classification	Number of carcasses	Leg	Shoulder	Back	Flank+ brisket	Neck	Fat-tail
Overall mean	101	2.86	1.61	1.69	2.20	0.55	1.04
Breed:							
Karakul	48	3.26a[*]	1.83a	1.91a	2.47a	0.62a	1.02
Naeini	53	2.48b	1.39b	1.47b	1.94b	0.48b	1.06
Age of ewe (years):							
4	11	2.65a	1.48a	1.58a	1.98a	0.50a	0.77
5	30	2.82a	1.57a	1.67a	2.11a	0.55ab	1.17
6	23	2.85a	1.64ab	1.66a	2.27ab	0.56ab	1.13
7+8	37	3.13b	1.75b	1.86b	2.46b	0.60b	1.10
Feedlot period (days):							
40	35	2.67a	1.55	1.53a	2.16	0.54	0.96
50	33	2.91b	1.61	1.76b	2.11	0.54	1.06
60	33	3.00b	1.67	1.77b	2.34	0.57	1.11

[†] The average of the right and left sides of carcass.

[*] Means within each subclass followed by the same letter are not significantly different at the 5% probability level (DMRT).

Table 2. Least squares means for differences between means of the wholesale cut weights as percent of chilled carcass weight[†].

Classification	Leg	Shoulder	Back	Flank+brisket	Neck	Fat-tail
Overall mean	28.5	16.0	16.8	21.8	5.5	10.3
Breed:						
Karakul	28.9	16.3	16.9	21.6	5.5	8.8a
Naeini	28.1	15.7	16.7	22.0	5.5	11.8b
Age of ewe (years):						
4	29.4	16.3	17.4	21.7	5.6	8.4
5	28.2	15.7	16.7	21.0	5.5	11.4
6	27.8	15.9	16.1	22.0	5.4	11.1
7+8	28.5	16.0	17.0	22.3	5.5	10.2
Feedlot period (days):						
40	27.9	16.2	16.0a*	22.4a	6.2a	9.8
50	28.9	15.9	17.5b	20.7b	5.1b	10.5
60	28.6	15.9	16.9b	22.2a	5.2b	10.6

[†] The average of the right and left sides of carcass relative to the half carcass weight.

* Means within each subclass followed by the same letter are not significantly different at the 5% probability level (DMRT).

percentages of chilled carcass weight were not different between the age groups, indicating that the differences between the age groups for the weight of the cuts were simply a reflection of heavier carcass weight in the older animals. Younger ewes were culled primarily due to poor condition, which explains why they were lighter compared to the older ewes.

The cut weights showed an upward trend as duration of stay in the feedlot increased, but the differences were significant only for the leg ($P < .05$) and the back ($P < .01$). Ewes which were slaughtered after 40 days in feedlot had lighter legs and backs as compared to those which were fed for 50 or 60 days. Changes in the percent cut weights did not follow any trend with respect to the length of feedlot stay; however, percent back, neck, and flank+brisket were significantly different among the three feedlot periods. The percent back was significantly lower and the percent neck was higher among the ewes which were slaughtered after 40 days in feedlot compared with the other two groups. None of the two-way interactions was significant.

The leg, shoulder, and back are traditionally considered as the prime wholesale cuts in Iran, and the neck and flank+brisket as the low value cuts. The tail fat used to be consumed as a major source of animal fat in the diet and as cooking oil. However, as a result of increased consumption of vegetable oil and butter in recent years, demand for excess carcass fat, as well as tail fat, has been declining. Consequently, tail fat has become the cheapest part of the carcass and demand for flank and brisket has been declining as well.

The results of this experiment indicated that fat-tail was the only cut which could influence the relative value of the carcass in these two breeds, resulting in generally lower values of the carcasses of Naeini ewes compared to the Karakul. There was no significant difference between the two breeds for weight of the cuts as percent chilled carcass without fat-tail. Therefore, to the extent that carcass value depends on the proportional weight of the different cuts, these two breeds with distinct differences in their mature weight had similar carcasses, disregarding fat-tail.

It was not practical to compare the percent wholesale cuts obtained in this experiment with those of the exotic breeds reported in the literature, mainly due to differences in the dissection techniques and the presence of fat-tail in the former group. Saleh *et al.* (17) studied the carcass composition of mature rams and ewes in four fat-tailed Iranian sheep breeds which were kept under three different levels of nutrition. There were some major differences in dissecting technique between their experiment and the present study for some of the cuts. The results of these two studies are not in complete agreement for the relative weights of the similar cuts. The main reason for the discrepancy seems to be due to large differences between the weight of fat-tail in the two experiments. When the weights of the similar cuts were computed as percent chilled carcass weight minus fat-tail , the adjusted means were found to be much more comparable than the unadjusted values. These adjusted values were more or less comparable with adjusted percentages of the similar cuts even in the carcasses of different fat-tailed breeds and sexes (12, 13, 16).

The weight and shape of fat-tail is under the influence of many genes and there is some evidence suggesting that different genes may affect this trait in different breeds (Makarechian and Farid, unpublished data). Considering the fact that the tail is a major fat depot in the fat-tailed breeds and fat is the most variable carcass tissue, a large degree of variability both between and within breeds for the weight of fat-tail is expected. Saleh *et al.* (17)

reported that mean percent fat-tail in the ewes of four native breeds ranged from 8.9 to 15.7 when animals were maintained under a maintenance level of nutrition, and from 12.2 to 20.7 among those which were fed above the maintenance level. Other reports indicate that the weight of fat-tail in fattened lambs of different Iranian breeds and sexes ranged between 6.39 to 25.26% (12, 13, 14, 16, 18). Such a large variation in the fat-tail weight relative to the carcass weight is much greater than the other commercial cuts. The standard error for the percent fat-tail was larger than those for the other cuts, indicating that fat-tail had the highest variation among the carcass cuts, even among the animals which were raised under uniform condition.

Bass *et al.* (1) studied the weight of cuts in culled ewes of some non-fat tailed breeds and crosses in New Zealand and found that the ranking order of the breeds for the weight of each cut corresponded with that for the carcass weight. When the cuts were adjusted for the chilled carcass weight, the differences between the breeds disappeared except for the ribs and flap, which could be due to differential fat deposition in various cuts. It might be logical to suggest that fat-tail plays an important role in keeping the relative weight of the cuts fairly constant by providing an additional fat depot, without which all the fat would have to be stored in other parts of the body, changing the relative weight of some cuts as a result of different fat storing capacity.

Meat, Subcutaneous Fat, and Bone in the Wholesale Cuts

Composition of the leg, shoulder, back, and neck. The least-squares means for weights of meat, subcutaneous fat, and bone in the leg, shoulder, back, and neck are shown in Tables 3 and ., and the mean of each component as a percentage of the cut weight is shown in Tables 5 and 6.

Table 3. Least squares means for differences between means of meat, bone, and subcutaneous fat weights in the leg and shoulder cuts from half carcasses (g)[†].

Classification	Number of cuts dissected	Leg			Shoulder		
		Meat	Fat	Bone	Meat	Fat	Bone
Overall mean	202	2053	395	416	1148	186	260
Ewe breed:							
Karakul	96	2364a[*]	380	482a	1326a	189	302a
Naeini	106	1743b	337	350b	970b	183	218b
Ewe age (years):							
4	22	1918a	316	398	1060a	160	240a
5	60	2021a	333	441	1136a	176	258ab
6	46	2030a	362	415	1150ab	193	267b
7+8	74	2242b	422	440	1146b	215	275b
Feedlot period (days):							
40	70	1940a	294a	405	1125	157	260
50	66	2085ab	362b	416	1133	190	257
60	66	2135b	419c	428	1186	210	263

[†]The average of the right and left sides.

[*]Means within each subclass followed by the same letter are not significantly different at the 5% probability level (DMRT).

Table 4. Least squares means for differences between means of meat, bone, and subcutaneous fat weights in the back and neck cuts from half carcasses (g)[†].

	Back			Neck		
Classification	Meat	Fat	Bone	Meat	Fat	Bone
Overall mean	1137	202	323	378	52	120
Ewe breed:						
Karakul	1292a*	228a	364a	459a	52	138a
Naeini	981b	176b	282b	314b	52	102b
Ewe age (years):						
4	1082	172a	298	407	46	108
5	1127	184a	330	374	44	123
6	1122	192a	332	357	56	123
7+8	1215	261b	334	407	61	125
Feedlot period (days):						
40	1031a	166	319	392	56	117
50	1186b	227	322	394	50	121
60	1193b	214	329	373	50	122

[†]The average of the right and left sides. Except for the bones, the weights of the other non-edible parts of the cuts are not reported because they were small and non significant.

*Means within each subclass followed by the same letter are not significantly different at the 5% probability level (DMRT).

Table 5. Least squares means for differences between means of meat, bone, and subcutaneous fat in the leg and shoulder as percentage of the cut weight[†].

Classification	Leg			Shoulder		
	Meat	Fat	Bone	Meat	Fat	Bone
Overall mean	72.0	12.4	14.7	72.3	11.4	16.4
Ewe breed:						
Karakul	72.8	11.3a*	15.0a	73.6a	9.9a	16.8
Naeini	71.3	13.6b	14.3b	70.9b	12.9b	16.0
Ewe age (years):						
4	72.6	12.1	15.1	72.5	10.9	16.5
5	71.8	11.8	14.7	72.7	11.2	16.6
6	71.5	12.4	14.6	72.7	11.5	16.8
7+8	72.2	13.3	14.1	71.5	12.2	15.8
Feedlot period (days):						
40	73.0	10.9	15.2a	73.5	10.5a	16.9
50	72.1	12.4	14.5ab	71.7	11.6ab	16.5
60	70.9	13.9	14.2b	71.5	12.7b	15.9

[†] The average of each component in the right and left sides relative to the average of the cut weight in the right and left sides.

* Means in each subclass followed by the same letter are not significantly different at the 5% probability level (DMRT).

Table 6. Least squares means for differences between means of meat, bone, and subcutaneous fat in the back and neck as percentage of the cut weight[†].

Classification	Back			Neck		
	Meat	Fat	Bone	Meat	Fat	Bone
Overall mean	68.0	11.7	19.6	70.0	8.5	21.1
Ewe breed:						
Karakul	68.4	11.4a*	19.6	74.8a	7.1a	21.6
Naeini	67.5	11.9b	19.6	65.3b	9.9b	20.6
Ewe age (years):						
4	69.2	10.9	19.3	80.6	8.7	20.7
5	68.1	11.0	20.2	67.9	7.2	21.7
6	68.2	11.1	20.4	63.8	9.0	21.5
7+8	66.3	13.5	18.4	68.0	9.0	20.5
Feedlot period (days):						
40	67.7	10.6	21.0a	67.7	8.5	20.7
50	67.8	12.3	18.7b	74.4	8.6	20.9
60	68.3	12.0	19.0ab	68.1	8.4	21.8

[†]The average of each component weight in the right and left sides relative to the average of the cut weight in the right and left sides. Except for the bone, the percent of other non-edible parts of the cuts ranged between 0.5 to 0.8 (not significant) and are not reported.

*Means within each subclass followed by the same letter are not significantly different at the 5% probability level (DMRT).

The weights of meat, subcutaneous fat, and bone as a percentage of the chilled carcass weight for these cuts in the two breeds are presented in Table 7. The Karakul

Table 7. Least squares means for differences between means of meat, subcutaneous fat, and bone as percentage of chilled carcasses in the two breeds†.

Trait	Breed of ewe	Leg	Shoulder	Back	Neck
Meat	Karakul	21.1a*	11.8a	11.5	4.20a
	Naeini	19.9b	11.1b	11.1	3.63b
Fat	Karakul	3.20a	1.60a	1.90	0.44a
	Naeini	3.80b	2.00b	2.00	0.59b
Bone	Karakul	4.30a	2.70a	3.30	1.24
	Naeini	4.00b	2.50b	3.20	1.17

†The subclass means are not reported because the differences between age groups and feedlot periods were not significant.

*Means within each subclass followed by the same letter are not significantly different at the 5% probability level (DMRT).

ewes had significantly ($P < .01$) higher amounts of meat than the Naeini ewes in all the cuts. When the meat weights were expressed as a percentage of the cut weights, the Karakul ewes were still superior over Naeini, but the differences were significant only for the shoulder and neck. The meat content of the cuts as a percentage of the chilled carcass was significantly higher for all the cuts in the Karakul as compared to the Naeini ewes, but the difference was not significant in case of the back.

The amount of subcutaneous fat in each cut in the two breeds was quite similar, except that the Karakul had more fat in the back. Subcutaneous fats as a percentage of cut weight and chilled carcass weight were significantly higher in Naeini than in Karakul, for all the cuts except the back where the two breeds were similar.

The bone weight (plus other non-edible parts in the leg and shoulder) was significantly higher in each cut in the Karakul than in the Naeini ewes, but the relative weight of this component with respect to the cut weight was significantly higher only in the leg of the Karakul ewes. The leg and shoulder of Karakul had a significantly higher percent bone with respect to the chilled carcass weight.

The weight of meat, subcutaneous fat, and bone tended to increase with age in most of the cuts, but the differences between the age groups were significant only in the case of meat in the leg and shoulder, subcutaneous fat in the back, and weight of bone in the shoulder. In all the cases, older age groups were heavier for all the cut components compared to the younger groups. All the cut components as percentages of the respective cut weight and chilled carcass weight were similar in all the cuts at each age. The bone weight as percent cut weight of the back was an exception, in which the difference between the age groups was small but significant. The percent bone among the 7- and 8-year old ewes was unexpectedly smaller than the 5- and 6-year old groups at the expense of higher percent subcutaneous fat.

The weight of meat and subcutaneous fat in the leg and the weight of meat in the back significantly increased as the feedlot period increased. The weight of subcutaneous fat as percent of cut weight tended to increase and percent meat and bone tended to decrease in all the cuts as stay in the feedlot continued, but the differences were not significant in most of the comparisons, except for fat in the leg and shoulder and bone in the leg and back. No difference was observed between the breeds, age groups, or feedlot period either for weight or for the percent of the non-edible parts of the cuts, which were measured separately in the back and neck.

The interaction between breed and age of ewe was significant for the weight of meat in the leg as percent of the cut weight and for the weight of subcutaneous fat in that cut. The percent leg meat was 75.2 in the 4-year old Karakul ewes which decreased to 70.6 in the 6-year old ewes and showed some further increase in the 7- and 8-year old group. In the Naeini ewes, on the other hand, the percent meat was 70.0 in the 4-year old ewes and increased to 72.3 in the 6-year old ewes. The weight of subcutaneous fat in the leg of the 4-year old Karakul ewes was 262 g which increased to 345, 407, and 508 g in the ewes 5, 6, and 7+8 years old respectively, while the corresponding values were 372, 320, 319, and 338 g in the Naeini ewes. It is difficult to explain the reasons for the differential amount of fat in different age groups within each breed. The significant interaction of breed by age for the percent meat in the leg was probably due to differences between the subclasses for the amount of subcutaneous fat.

Meat+fat and bone in the flank+brisket. Both meat+fat and bone weights were significantly higher in the flank+brisket of the Karakul compared to the Naeini ewes (Table 8). As the meat+fat and bone weight were expressed as a percent of the cut weight, the breed difference disappeared for the former component, while the bone percentage was still higher in the Karakul. However, the differences were small. Weight of meat+fat and bone significantly increased with age, but none of the percentages was significant. Weight and percentages of meat+bone in the flank+brisket were somewhat lower in those ewes which were slaughtered after

Table 8. Least squares means for differences between means of meat+fat and bone weights in flank+brisket and their percentages relative to the chilled carcass and flank+brisket weights.

	Weights (g)		As percent chilled carcass		As percent cut weight	
Classification	Meat+fat	Bone	Meat+fat	Bone	Meat+fat	Bone
Overall mean	1943	237	19.2	2.4	88.4	11.0
Ewe breed:						
Karakul	2185a*	276a	19.1	2.5a	87.9	11.6a
Naeini	1700b	198b	19.2	2.3b	88.9	10.4b
Ewe age (years):						
4	1734a	216a	19.1	2.4	88.8	11.2
5	1863a	233ab	18.6	2.3	88.8	11.3
6	2003ab	246bc	19.4	2.4	87.2	10.9
7+8	2170b	253c	19.6	2.3	88.7	10.6
Feedlot period (days):						
40	1908	236	19.8a	2.5	89.1	11.1
50	1845	231	18.1b	2.3	85.5	11.3
60	2074	244	19.7a	2.3	88.5	10.6

*Means within each subclass followed by the same letter are not significantly different at the 5% probability level (DMRT).

50 days in the feelot compared to the other two categories. This difference, which could be attributed to sampling, resulted in a significantly lower proportion of meat+fat with respect to the chilled carcass in this category compared to those which were slaughtered after 40 or 60 days in feedlot.

The results generally suggested that the main difference between the wholesale cuts in the Karakul and Naeini ewes was due to their subcutaneous fat content. The Naeini ewes deposited relatively more fat in almost all the cuts compared to the Karakul ewes. The difference between the two breeds for percent subcutaneous fat was minimal in the back, which may be indicative of breed differences in the relative amount of fat stored in each depot. The equality of the two breeds for the backfat thickness (7) confirms this hypothesis. It might be hypothesized that one of the biological functions of the fat-tail is to keep the backfat thickness relatively constant among the breeds.

Even though the Karakul ewes had a higher percent meat in the shoulder and neck, this does not necessarily mean more protein content in those cuts, because breed differences in the proportions of intermuscular fat are evident(8). If the percentage of meat was considered as the only criterion to evaluate the relative price of each wholesale cut, the leg and shoulder would have the same value, followed by the neck and back. However, the differences between the percent meat content of these four cuts were less than 6%. The particular anatomical structure of the neck would certainly affect its ranking order. If the total edible part (meat+fat) was considered as the main criterion to evaluate each wholesale cut, the cuts would have been ranked as flank+brisket, leg, shoulder, back, and neck. Despite the differences for tissue separation between this experiment and that reported by Saleh *et al.* (17), the relative composition of the comparable cuts are not considerably different in the two experiments.

The results also indicated that the relative value of the different wholesale cuts, evaluated on the basis of percent meat, did not change with age. Nevertheless, the proportion of inter- and intra-muscular fat, and the quality of meat might be different between the age groups. Ten days difference between the successive slaughters was not apparently long enough to create an appreciable difference in percent composition in most of the cuts. It seems that the rate of fat deposition in the leg and shoulder was so high that it resulted in a significant increase in the percent of subcutaneous fat among the different periods in these cuts. It has been shown in old ewes that as the total body fat increases, the subcutaneous fat increases at a faster rate than any other fat depot (15).

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