Iran J. agric. Res. Vol. 7, No. 1, 1979, pp. 11–23. Pergamon Press. Printed in Great Britain.

MEAT FROM CULLED OLD EWES OR FAT-TAILED IRANIAN BREEDS – I. FEEDLOT PERFORMANCE AND SOME CARCASS TRAITS[1]

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Abstract – Data on 101 4–8-year old ewes of two fat-tailed Iranian breeds of sheep, Karakul and Naeini, were used in this study. The ewes were culled from the breeding flock primarily for age and/or poor body condition and were fattened for 40, 50 or 60 days and slaughtered.

Final weight of Karakul ewes was, on the average, about 10 kg heavier than that of Naeini ewes, but significant differences were not found for feedlot daily gain or feed conversion. Final weight significantly increased by age, but average feedlot daily gain and feed conversion were not influenced by this factor. The length of the fattening period did not influence the feedlot gain and efficiency.

Relatively more fatty tissue was deposited around the internal organs (kidney fat, pericardial fat, omental and mesenteric fat) by Naeini ewes. Age did not significantly influence the internal and subcutaneous fat. Kidney fat was found to be the most mobile type of internal fat and significantly increased as the fattening period increased.

The weights of non-carcass components (hide, head, feet, kidneys, lungs, heart and liver) were significantly higher in Karakul ewes, but the weight of these organs when expressed as a percentage of slaughter weight was similar in the two breeds. Changes in weight of organs by fattening period was very gradual and non-significant.

Karakul ewes had significantly heavier cold carcass weight and larger eye muscle dimension. Dressing percentages of the breeds did not differ significantly. Cold carcass weight was increased by age but eye muscle dimensions and dressing percentage were independent of age effect and fattening period.

INTRODUCTION

Fattening old sheep is a common practice in Iran. The cause of operation of this inefficient method of large scale sheep production can be summarized as follows:

(1) A high majority of sheep population is managed under a migratory system of production by tribesmen who are utilizing overgrazed pastures [15] without any feed supplementation. Consequently, the lambs do not reach a marketable weight and will be

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1. Contribution from the Department of Animal Science, College of Agriculture, Shiraz University, Shiraz, Iran. This project was supported by Shiraz University Agricultural Research Center.

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kept for another year or even longer until they are heavy enough to be marketed.

Only relatively young ewes can stand the harsh environmental conditions which prevail under the migratory system of production. Old ewes (older than five years) usually cannot travel long distances, and cannot utilize the coarse and often scarce vegetations. Therefore, as a result, there is not enough lamb for feedlot operation, but generally there is a good supply of old ewes and mature rams.

(2) Seasonal price fluctuation of meat also contributes to this method of production. The tribesmen usually sell their surplus stock in early fall before their long journey to winter ranges. This practice lowers the meat price to its minimum level. The feedlot operators buy these sheep for fattening and the animals are marketed at the end of winter when the meat price is generally at its peak. The seasonal difference in meat price is an important element of their operation.

Reliable information concerning rate of growth, efficiency of gain and carcass characteristics of old ewes fattened in Iranian drylots was not available. The purpose of this study was to compare the performance of two native breeds of fat-tailed ewes and some of their carcass traits when fattened in drylot and to make some preliminary comparison with the feedlot performance of lambs of the same breeds based on previous experiments [2, 10, 11, 12].

MATERIALS AND METHODS

This study involved 101 culled old ewes of two fat-tailed Iranian breeds of sheep; Karakul and Naeini. The breeds are known as range sheep, but the sheep involved in this study were managed under farm conditions in the Animal Experimental Station of the University for four years. A description of these breeds and management practices of the flock has been published previously [3].

In order to restrict the size of the experimental flock, some of the ewes of each of the two breeds were culled in late summer prior to the breeding season. Culling was based on age, irregular or broken teeth, weakness and general condition of the ewe compared to the average condition of the flock. The age range among the culled ewes was from 4 to 8 years. All the ewes had lambed in the spring and were grazed on farm residuals, mainly wheat and barley stubble and some very poor range in the summer.

The feedlot experiment started in October, 1976. The ewes were individually fed a complete pelleted ration *ad libitum*. The fattening ration contained 45% alfalfa hay and 55% concentrate and mineral supplements. The ingredient and chemical composition of the ration are presented in Table 1. The animals were weighted at the beginning and the termination of the feeding period. The feed intake of each ewe was determined to the nearest 0.05 kg. Due to limitations in the facilities for slaughtering and carcass evaluation, the ewes were randomly slaughtered in three different groups after 40, 50 and 60 days in the feedlot.

At the termination of the feeding period the ewes were taken off feed and water for 14 hr. The animals were slaughtered according to accepted procedures. After slaughter and skinning, all the abdominal and thoracic organs were removed. The edible internal organs (kidneys, lungs, heart and liver), hide, head and feet were weighed. The fatty tissues surrounding kidney (kidney fat), heart (pericardial fat) and those in the abdominal

Table 1. Ingredient and chemical composition of the ration

Ingredients	%	Chemical composition*	%
Alfalfa	45.0	Dry matter	91.8
Barley	30.0	Crude protein	15.1
Cotton seed meal	5.0	Crude fat	2.0
Dried beet pulp	18.0	Crude fiber	20.2
Salt	1.0	Ash	8.1
Bone meal	1.0		

* 90% dry matter basis.

cavity (omental and mesenteric fat) were separated and weighed (mesenteric fat included fat from the mesentery, plus associated lymphatic glands and fatty tissues scraped from the surface of the large intestine). All weights were measured to the nearest 5 g. The warm carcass was weighed immediately after dressing and removal of offal parts. The carcass was chilled at from −1 to +3°C for approx. 20 hr and then weighed to determine the dressing percentage. The cold carcass was separated into two parts by cutting between the 12th and 13th ribs perpendicular to the back. The cross section of the *Longissimus dorsi* muscle was measured by planimeter three times and the average was considered as the area of one side of the loin eye muscle. The area of the other side was measured in the same manner and the average area of both sides was used as the area of loin eye muscle of each ewe. The following measurements were also recorded on both sides of the carcass and the averages were taken (Fig. 1). (*A*) Thickness of backfat over the deepest part of the eye muscle; (*B*) thickness of backfat over the edge of the eye muscle opposite to the spinal process; (*L*) length of the eye muscle; the maximum distance across the cross-section surface of the eye muscle from the end next to the spinal process outward along the rib; (*D*) depth of the eye muscle; the greatest distance at right angles to "*L*" on the same surface.

Due to the unequal numbers of observations in the sub-classes, data were analysed by the least-squares procedure [7]. Seven- and 8-year old ewes were classified in one

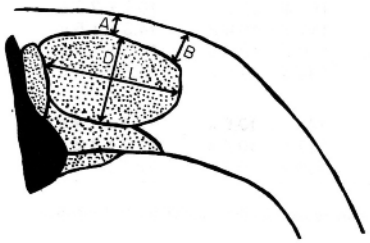

Fig. 1. Diagram of the cross section between the 12th and 13th ribs showing locations of measurements of fat thickness (*A, B*), length (*L*) and width (*D*) of the *Longissimus dorsi* muscle. Dotted areas represent muscle and the dark area represents bone.

group since there were only a few 8-year old ewes. Breed of the ewe, age of the ewe and feedlot period were considered to be main effects. The interaction between breed of the ewe and feedlot period were also considered in the model.

Pair-wise tests of significance among the least-squares means were performed using Duncan's multiple range test [1] as modified by Kramer [3]. Standard errors of estimates were calculated from the appropriate terms of the variance-covariance matrix.

RESULTS AND DISCUSSION

Feedlot performance

The analysis of variance and least-squares means for final weight, average feedlot daily gain and feed conversion are presented in Tables 2 and 3, respectively. Breed performance was similar except for final weight. Karakul ewes were heavier than Naeini ewes at the

Table 2. Least-squares analysis of variance for feedlot traits (mean squares)

Source of variation	d.f.	Final weight	Feedlot daily gain	Feed conversion
Breed of ewe (*B*)	1	2220.3*	5424.0	70.3
Age of ewe (*A*)	3	120.8*	4029.0	41.3
Fattening period (*P*)	2	81.0	4645.5	19.9
B X *A* interaction	3	58.3	1053.0	54.3
B X *P* interaction	2	80.8	1577.0	4.8
Error	89	27.9	2770.6	55.7

* Significant at $p < 0.01$.

Table 3. Least-squares means, standard errors, and test of significance for differences between means of feedlot traits

Classification	No. of ewes	Final weight (kg)	Average feedlot daily gain (g)	Feed conversion, kg feed/kg gain
Overall mean	101	42.9 ± 0.6	131.5 ± 6.2	12.9 ± 0.9
Breed of ewe:				
Karakul	48	48.4 ± 0.8 a*	140.3 ± 8.5 a	13.9 ± 1.2 a
Naeini	53	37.3 ± 0.9 b	122.8 ± 9.0 a	22.0 ± 1.3 a
Age of ewe (years):				
4	11	39.6 ± 1.6 a	151.4 ± 16.2 a	10.2 ± 2.3 a
5	30	42.3 ± 1.0 a	117.2 ± 10.4 a	14.3 ± 1.5 a
6	23	43.3 ± 1.2 ab	119.2 ± 12.3 a	13.5 ± 1.7 a
7 and 8	37	46.2 ± 1.1 b	138.3 ± 11.2 a	13.5 ± 1.6 a
Fattening period (days)				
40	35	41.4 ± 1.0 a	143.7 ± 10.0 a	12.8 ± 1.4 a
50	33	42.6 ± 1.0 a	117.8 ± 10.4 a	13.7 ± 1.5 a
60	33	44.6 ± 0.9 a	133.1 ± 9.6 a	12.1 ± 1.3 a

*All means within a particular subclass differ significantly ($p < 0.05$) except those followed by the same letter.

end of the drylot period ($p < 0.01$). Farid and Makarechian [3] reported that Naeini ewes were lighter than Karakuls, at breeding, lambing and weaning time, indicating that the observed difference in final weight at the termination of the feedlot period was due to the original difference which existed between two groups from the beginning of the experiment.

The least-squares means of average daily gain in each breed group did not differ greatly from the average daily gains of lambs of the same breed, but the ewes were half as efficient as the lambs of their respective breed in feed conversion [2, 11, 12]. It must be noted that the ewes in this experiment were fed a superior ration (higher in energy and protein) in pelleted form and were fattened in a more suitable climatic condition (fall vs summer), compared with the lamb feeding experiments. It is safe to assume that feedlot operators who fatten old ewes, have been considering daily gain only and are generally unaware of the fact that old ewes are very inefficient in feed conversion.

Among the feedlot traits, age of ewe had considerable influence only on final weight ($p < 0.01$). Final weight increased with the increase in age of ewe, but significant differences were observed only between the 7- and 8-year old age group and 4- and 5-year old groups in favor of the former group. These results are in agreement with the results reported by Farid and Makarechian [3]. The younger ewes had generally lower initial weight compared with the older ones (culling was primarily on the basis of poor body condition in younger ewes) and apparently there was not much compensatory gain in the feedlot to overcome the initial weight differences.

The influence of age of ewe on feedlot daily gain and feed conversion was not considerable. However, 4-year old ewes performed better than the other age groups as far as these traits were concerned. Feedlot period did not have a significant influence on any of the traits, which may be explained by the fact that the differences in lengths of feeding periods were small. The interactions between breed and age of the ewe and between breed of the ewe and feedlot period were not important sources of variation for the traits studied.

Internal fat

Least-squares means of kidney fat, pericardial fat, omental and mesenteric fat, and total internal fat (the sum of the 4 measurements) are presented in Table 4. Although, on the average, Karakul ewes were approx. 10 kg heavier than Naeini ewes in slaughter weight (Table 3), nevertheless, the differences between the two breeds in internal fat were very small and non-significant. When the internal fat was expressed as a percentage of slaughter weight (Table 5), it was found that more fat per unit live weight had been deposited in Naeini ewes compared with the Karakuls. The differences between the two breeds in percentage of fat deposits were all significant except for kidney fat. The high rate of fat deposition in Naeini ewes, for which they are well known, is probably one of the main contributing factors to their hardiness. The ability for high rate of fat deposition under favourable nutritional conditions might have been the result of natural selection, enabling the individuals possessing this ability to survive under very poor range conditions. Robison [14] reported that internal fat deposition by 3-year old ewes when fed supermaintenance ration was not linear. He found that the fat deposition was slow at first and became rapid later as feeding continued. It is probable that breeds with the ability for high rates of fat deposition such as Naeini, enter the stage of rapid fat

Table 4. Least-squares means, standard errors and test of significance for differences between means of fat depots

Classification	Kidney fat (kg)	Pericardial fat (kg)	Omental and mesenteric fat (kg)	Total internal fat (kg)	Subcutaneous fat (mm)†	
					A	*B*
Overall mean	0.36 ± 0.02	0.08 ± 0.00	0.90 ± 0.07	1.34 ± 0.09	4.5 ± 0.2	7.5 ± 0.3
Breed of ewe:						
Karakul	0.37 ± 0.03 a*	0.08 ± 0.00 a	0.90 ± 0.09 a	1.36 ± 0.12 a	4.4 ± 0.3 a	7.6 ± 0.4 a
Naeini	0.35 ± 0.04 a	0.08 ± 0.00 a	0.90 ± 0.10 a	1.32 ± 0.13 a	4.6 ± 0.3 a	7.4 ± 0.4 a
Age of ewe (years):						
4	0.39 ± 0.06 a	0.07 ± 0.01 a	0.89 ± 0.18 a	1.35 ± 0.23 a	3.9 ± 0.5 a	7.8 ± 0.7 a
5	0.32 ± 0.04 a	0.08 ± 0.00 a	0.71 ± 0.11 a	1.12 ± 0.15 a	4.5 ± 0.3 a	6.9 ± 0.5 a
6	0.36 ± 0.05 a	0.09 ± 0.01 a	0.95 ± 0.14 a	1.40 ± 0.18 a	4.4 ± 0.4 a	7.1 ± 0.5 a
7 and 8	0.36 ± 0.04 a	0.09 ± 0.00 a	1.05 ± 0.12 a	1.50 ± 0.16 a	5.2 ± 0.4 a	8.3 ± 0.5 a
Fattening period (days):						
40	0.27 ± 0.04 a	0.08 ± 0.00 a	0.81 ± 0.11 a	1.16 ± 0.14 a	4.5 ± 0.3 a	5.8 ± 0.4 a
50	0.33 ± 0.04 a	0.09 ± 0.00 a	0.89 ± 0.11 a	1.31 ± 0.15 a	4.4 ± 0.3 a	7.7 ± 0.5 b
60	0.48 ± 0.04 b	0.08 ± 0.00 a	1.01 ± 0.11 a	1.56 ± 0.14 a	4.6 ± 0.3 a	9.1 ± 0.4 c

*All means within a particular subclass differ significantly ($p < 0.05$) except those followed by the same letter.

†Average of left and right sides.

Table 5. Least-squares means, standard errors and test of significance for differences between means of internal fats as percentages of slaughter weight

Classification	Percentage of slaughter			
	Kidney fat (kg)	Pericardial fat (kg)	Omental and mesenteric fat (kg)	Total internal fat (kg)
Overall mean	0.81 ± 0.05	0.20 ± 0.01	2.05 ± 0.12	3.07 ± 0.16
Breed of ewe:				
Karakul	0.75 ± 0.07 a*	0.18 ± 0.01 a	1.76 ± 0.17 a	2.69 ± 0.22 a
Naeini	0.88 ± 0.07 a	0.22 ± 0.01 b	2.34 ± 0.17 b	3.44 ± 0.22 b
Age of ewe (years):				
4	0.91 ± 0.13 a	0.20 ± 0.02 a	2.18 ± 0.32 a	3.29 ± 0.42 a
5	0.75 ± 0.08 a	0.19 ± 0.01 a	1.70 ± 0.20 a	2.65 ± 0.27 a
6	0.80 ± 0.10 a	0.21 ± 0.01 a	2.08 ± 0.24 a	3.09 ± 0.32 a
7 and 8	0.79 ± 0.09 a	0.21 ± 0.01 a	2.25 ± 0.22 a	3.24 ± 0.29 a
Fattening period (days):				
40	0.63 ± 0.08 a	0.21 ± 0.01 a	1.89 ± 0.19 a	2.74 ± 0.26 a
50	0.76 ± 0.08 a	0.20 ± 0.01 a	2.02 ± 0.20 a	2.99 ± 0.27 a
60	1.04 ± 0.07 b	0.18 ± 0.01 a	2.24 ± 0.19 a	3.47 ± 0.25 a

*All means within a particular subclass differ significantly ($p < 0.05$) except those followed by the same letter.

deposition earlier than do other breeds.

There were not any detectable age effects on the weight of internal fats or the weight of internal fats when expressed as percentages of slaughter weight. It must be noted that the 4-year old ewes were culled mainly due to their generally poor condition and weakness, and, therefore, are not quite comparable with the other age groups which were culled mainly because of age. Ignoring the 4-year old group, there was a trend for higher fat deposition as the age increased. Movassagh [13] reached the same conclusion in 1- and 2-year old Karakul ewes.

The weights of kidney fat, omental and mesenteric fat, and the total internal fat increased with the length of the fattening period, but the differences were significant only for the kidney fat (Table 4). Based on these results, it is probable that kidney fat is the most and pericardial fat the least mobile type of internal fat depots. Kidney fat increased by approximately 77%, omental and mesenteric fat by 24% and pericardial fat showed no increase as a result of longer periods of feedlot. Robison [14] reported that kidney fat showed the greatest range of gain followed by mesenteric fat in 3-year old ewes when fed supermaintenance ration. Movassagh [13] reported a higher rate of change in omental and mesenteric fat, compared with pericardial fat in Karakul ewes, subjected to restricted feeding below the maintenance level.

When internals fats were expressed as percentage of slaughter weight, kidney fat, omental and mesenteric fat, and the total internal fat increased with the increase in the duration of the feedlot period, the differences were not significant except for kidney fat. The percentage of pericardial fat decreased as the fattening period increased (mainly due to an increase in carcass weight of the animal), although the change was very small and non-significant.

The interaction between the breed and the age of ewe was a significant source of variation for pericardial fat and the total internal fat, indicating that the rate of fat deposition around the heart differed in the two breeds with an increase in age. The interaction between breed of ewe and fattening period was not significant for the traits studied. There was no significant interaction for internal fats when fat weights were expressed as a percentage of slaughter weight.

Subcutaneous fat

The least-squares means for subcutaneous fat at two points over the *Longissimus dorsi* muscle are shown in Table 4. The breeds were not different in backfat thickness. Backfat thickness when measured at point *B*, over the edge of the eye muscle opposite the spinal process increased as the length of the fattening period increased ($p < 0.01$). The interactions between breed and age of ewe and breed of ewe and fattening period were not a significant source of variation in subcutaneous fat.

Non-carcass components

Some of the non-carcass components such as head, feet, kidneys, heart and liver are used as human food in the region and the rest are also important economically. All the non-carcass components of Karakul ewes were heavier ($p < 0.01$) than Naeini ewes (Table 6). This was expected since the Karakul ewes were also heavier than Naeini (Table 3). Significant differences were observed between the breeds only for the weights of liver and lungs among the non-carcass components, when they were expressed as percentages of slaughter weight. Lungs had a higher and liver had a lower percentage value in Karakul compared with Naeini ($p < 0.05$).

The weights of hide, head, feet and kidneys increased with age, but the rate of increase was significant only for hide, feet and kidneys. Age of the ewe did not have a significant effect on any of the non-carcass component weights, when the weights were expressed as percentages of the slaughter weight.

The feedlot period had a significant influence on the weight of feet and kidneys when they were measured as percentages of the slaughter weight ($p < 0.05$). Gaili *et al.* [4] reported a significant decrease in hide weight relative to slaughter weight in male Sudan desert sheep when fattened for 60 days. Hide weight was 8.8% of the slaughter weight, which is very close to the estimate found in this study. There are some reports which suggest that the weights of some non-carcass components change when ewes are fed either above-maintenance or below-maintenance rations for a relatively long period [13, 14].

There was a significant interaction between breed and age of the ewe for the weight of feet. Significant interactions between breed of ewe and fattening period were observed for the weights of kidneys and lungs. When the weights of non-carcass components were expressed as percentages of the slaughter weight, a significant interaction between breed and fattening period for the weight of the head was observed

Carcass traits

Karakul ewes had heavier cold carcasses than Naeinies ($p < 0.01$). The weight of cold carcasses increased with age ($p < 0.05$). The carcasses of 7- and 8-year old ewes were heavier than those of 4-year old ewes. Duration of the fattening period did not have a significant influence on cold carcass weight, which was probably due to the small

Table 6. Least-squares means, standard errors and test of significance for differences between means of some non-carcass components

Classification	kg weight of						
	Hide	Head	Feet	Kidneys	Lungs	Heart	Liver
Overall mean	3.80 ± 0.08	2.06 ± 0.04	0.80 ± 0.01	0.13 ± 0.00	0.49 ± 0.01	0.19 ± 0.00	0.73 ± 0.01
Breed of ewe:							
Karakul	4.35 ± 0.11 a*	2.37 ± 0.05 a	0.92 ± 0.02 a	0.14 ± 0.00 a	0.58 ± 0.01 a	0.21 ± 0.01 a	0.77 ± 0.01 a
Naeini	3.25 ± 0.12 b	1.74 ± 0.05 b	0.68 ± 0.02 b	0.12 ± 0.00 b	0.40 ± 0.01 b	0.17 ± 0.01 b	0.69 ± 0.02 b
Age of ewe (years):							
4	3.39 ± 0.22 a	1.94 ± 0.10 a	0.74 ± 0.03 a	0.12 ± 0.01 a	0.45 ± 0.02 a	0.18 ± 0.01 a	0.72 ± 0.03 a
5	3.75 ± 0.14 a	2.04 ± 0.06 a	0.78 ± 0.02 a	0.13 ± 0.00 b	0.52 ± 0.01 a	0.20 ± 0.01 a	0.73 ± 0.02 a
6	3.81 ± 0.16 ab	2.10 ± 0.07 a	0.79 ± 0.02 a	0.13 ± 0.00 b	0.49 ± 0.02 a	0.18 ± 0.01 a	0.74 ± 0.02 a
7 and 8	4.26 ± 0.15 b	2.15 ± 0.07 a	0.89 ± 0.02 b	0.14 ± 0.00 b	0.51 ± 0.01 a	0.20 ± 0.01 a	0.73 ± 0.02 a
Fattening period (days):							
40	3.76 ± 0.13 a	2.04 ± 0.06 a	0.80 ± 0.02 a	0.13 ± 0.00 a	0.49 ± 0.01 a	0.19 ± 0.01 a	0.74 ± 0.02 a
50	3.70 ± 0.14 a	2.00 ± 0.06 a	0.78 ± 0.02 a	0.13 ± 0.00 a	0.49 ± 0.01 a	0.19 ± 0.01 a	0.73 ± 0.02 a
60	3.94 ± 0.13 a	2.13 ± 0.06 a	0.82 ± 0.02 a	0.13 ± 0.00 a	0.49 ± 0.01 a	0.20 ± 0.01 a	0.75 ± 0.02 a

*All means within a particular subclass differ significantly ($p < 0.05$) except those followed by the same letter.

differences among the durations of the fattening periods (Table 8). It was not possible to obtain reliable measurements of shrinkage because the cooling facility was too small to provide uniform cooling rates.

Karakul ewes had longer loin eye muscles than Naeinies ($p < 0.05$), but there were significant differences in the length and area of the muscle between the two breeds. Age did not have any appreciable effect on the length, depth or area of the eye muscle. Gaili *et al.* [4] reported a significant increase in the area of loin eye muscle with an increase in age when they compared young, yearling and mature male Sudan desert sheep.

Duration of the fattening period did not influence the loin eye muscle dimensions greatly. This was probably due to the small differences in length of fattening periods. Gaili *et al.* [4] reported a considerable increase in eye muscle area during a 60-day feedlot period. The interaction between breed of ewe and fattening period was a significant source of variation in the length of loin eye muscle.

Dressing percentage

Breed of ewe, age of ewe, fattening period and their two-way interactions had no significant influence on the dressing percentage (Table 8). The calculated dressing percentages of the two breeds are comparable to those reported by Labusca *et al.* [9] for ewes culled as a result of age and low performance. An upward trend in dressing percentage was observed to be associated with an increase in age. This was probably due to the higher growth rates of carcass tissues, especially muscle and fat, and the slower rate of growth of the earlier developing body parts [5]. Most of the non-carcass components considered in this study were among the early developing parts of the body (liver, head, lungs and heart). Their weight relative to slaughter weight decreased as age increased (Table 7).

Gaili *et al.* [4] reported a significant increase in dressing percentage in male Sudan desert sheep by fattening. Hankins *et al.* [6] also found an improvement in the dressing percentage of Karakul ewes with an increased degreee of fatness. This observation, similar to the effect of age, is due to the relatively higher rate of growth of carcass tissues, especially muscle and fat, and the slower rate of growth, or in some cases no change, in weight of the internal organs.

Acknowledgments – Cooperation of Dr. A. Kashirad, Director of the Shiraz University Agricultural Research Center at the time the research was done, is acknowledged. The authors express appreciation to Dr. G. Pajomand, Head of the Computer Center, for providing facilities and computer time for the statistical analyses. Appreciation is also extended to Miss F. Saadat for typing of the manuscript.

Table 7. Least-squares means, standard errors and test of significance for differences between means of some non-carcass components as percentages of slaughter weight

Classification	Percentage of slaughter weight						
	Hide	Head	Feet	Kidneys	Lungs	Heart	Liver
Overall mean	8.8 ± 0.1	4.8 ± 0.1	1.87 ± 0.02	0.31 ± 0.00	1.15 ± 0.02	0.45 ± 0.01	1.74 ± 0.03
Breed of ewe:							
Karakul	8.9 ± 0.2 a*	4.9 ± 0.1 a	1.90 ± 0.03 a	0.30 ± 0.01 a	1.22 ± 0.03 a	0.44 ± 0.02 a	1.62 ± 0.04 a
Naeini	8.7 ± 0.2 a	4.7 ± 0.1 a	1.83 ± 0.03 a	0.32 ± 0.01 a	1.08 ± 0.03 b	0.46 ± 0.02 a	1.87 ± 0.04 b
Age of ewe (years):							
4	8.5 ± 0.4 a	4.9 ± 0.2 a	1.88 ± 0.05 a	0.30 ± 0.01 a	1.14 ± 0.05 a	0.45 ± 0.04 a	1.83 ± 0.08 a
5	8.8 ± 0.2 a	4.8 ± 0.1 a	1.85 ± 0.03 a	0.31 ± 0.01 a	1.22 ± 0.03 a	0.47 ± 0.03 a	1.77 ± 0.05 a
6	8.8 ± 0.3 a	4.8 ± 0.2 a	1.84 ± 0.04 a	0.31 ± 0.01 a	1.12 ± 0.04 a	0.42 ± 0.03 a	1.75 ± 0.06 a
7 and 8	9.2 ± 0.3 a	4.7 ± 0.1 a	1.90 ± 0.03 a	0.30 ± 0.01 a	1.10 ± 0.04 a	0.44 ± 0.03 a	1.62 ± 0.05 a
Fattening period (days):							
40	9.0 ± 0.2 a	4.9 ± 0.1 a	1.94 ± 0.03 a	0.32 ± 0.01 a	1.18 ± 0.03 a	0.47 ± 0.02 a	1.82 ± 0.05 a
50	8.7 ± 0.2 a	4.7 ± 0.1 a	1.83 ± 0.03 b	0.29 ± 0.01 b	1.17 ± 0.03 a	0.42 ± 0.03 a	1.69 ± 0.05 a
60	8.8 ± 0.2 a	4.8 ± 0.1 a	1.83 ± 0.03 b	0.30 ± 0.01 ab	1.10 ± 0.03 a	0.44 ± 0.02 a	1.72 ± 0.05 a

*All means within a particular subclass differ significantly ($p < 0.05$) except those followed by the same letter.

Table 8. Least-squares means, standard errors and test of significance for differences between means of carcass traits and dressing percentage

Classification	No. of ewes	Cold carcass (kg)	Shrinkage† (kg)	Shrinkage, as percentage of hot carcass	Longissimus dorsi‡			Dressing percentage
					Length (cm)	Depth (cm)	Area (cm^2)	
Overall mean	101	20.2 ± 0.4	0.59 ± 0.14	2.9 ± 0.05	5.78 ± 0.05	2.75 ± 0.04	12.79 ± 0.22	46.9 ± 0.04
Breed of ewe:								
Karakul	48	22.7 ± 0.5 a*	0.58 ± 0.19 a	2.6 ± 1.0 a	5.97 ± 0.06 a	2.82 ± 0.05 a	13.70 ± 0.30 a	46.6 ± 0.05 a
Naeini	53	17.7 ± 0.6 b	0.60 ± 0.20 a	3.2 ± 1.1 a	5.59 ± 0.06 b	2.67 ± 0.05 a	11.87 ± 0.32 b	47.2 ± 0.6 a
Age of ewe (years):								
4	11	18.1 ± 1.0 a	0.70 ± 0.37 a	3.7 ± 1.9 a	5.65 ± 0.12 a	2.70 ± 0.10 a	12.05 ± 0.57 a	45.7 ± 1.0 a
5	30	20.0 ± 0.6 ab	0.72 ± 0.24 a	3.6 ± 1.2 a	5.76 ± 0.08 a	2.70 ± 0.06 a	12.39 ± 0.37 a	47.3 ± 0.7 a
6	23	20.6 ± 0.8 ab	0.42 ± 0.28 a	2.0 ± 1.4 a	5.83 ± 0.09 a	2.75 ± 0.07 a	13.06 ± 0.43 a	47.4 ± 0.8 a
7 and 8	37	22.0 ± 0.7 b	0.50 ± 0.25 a	2.3 ± 1.3 a	5.89 ± 0.08 a	2.83 ± 0.07 a	13.65 ± 0.39 a	47.4 ± 0.7 a
Fattening period (days):								
40	35	19.2 ± 0.6 a	0.58 ± 0.23 a	3.0 ± 1.2 a	5.83 ± 0.07 a	2.70 ± 0.06 a	12.70 ± 0.35 a	46.4 ± 0.6 a
50	33	20.2 ± 0.6 a	0.54 ± 0.24 a	2.7 ± 1.2 a	5.75 ± 0.07 a	2.71 ± 0.06 a	12.40 ± 0.37 a	47.2 ± 0.6 a
60	33	21.1 ± 0.6 a	0.64 ± 0.22 a	2.9 ± 1.1 a	5.76 ± 0.07 a	2.82 ± 0.06 a	13.27 ± 0.34 a	47.2 ± 0.6 a

*All means within each particular subclass differ significantly ($p < 0.05$), except those followed by the same letter.

†(Hot carcass weight)−(cold carcass weight).

‡Average of right and left sides.

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