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Relationships between chemical composition of meat from carcass cuts and the whole carcass in Iranian fat-tailed sheep as affected by breed and feeding level

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Summary

To investigate the relationship between chemical composition of meat from the carcass cuts and the whole carcass, 48 nine-month-old randomly selected ram lambs of Ghezel and Mehraban (24 rams per breed) were used in a trial arranged as a 2 × 2 factorial experiment with two breeds and two feeding levels (high and low), in a completely randomized design. After 80 days, all animals were slaughtered and the right side of the carcass was cut into the leg, shoulder, back, neck, brisket and flap joints. Dry matter (DM), crude protein (CP), crude fat and ash were determined in meat from individual cuts and combined meat of all cuts (carcass meat). In general, average meat composition was not significantly affected by breed, feeding level and their interaction. Significant correlations were found between chemical composition of meat in most carcass cuts and carcass meat. Carcass DM in Ghezel sheep was highly correlated ($P<0.001$) with shoulder ($r = 0.81$) and back ($r = 0.74$) meat DM. In Mehraban sheep, back meat DM showed the highest correlation with carcass meat DM ($r = 0.84$, $P<0.001$). Back CP was significantly correlated with carcass meat CP in both breeds ($r = 0.80$, $P<0.001$). Carcass meat fat was significantly ($P<0.001$) correlated with back fat in both Ghezel ($r = 0.76$) and Mehraban ($r = 0.84$). In Ghezel, correlation coefficients of carcass meat ash and other parameters were generally small and non-significant. In Mehraban, carcass meat ash showed a small correlation with shoulder ash ($r = 0.58$, $P<0.01$) followed by back ($r = 0.49$, $P<0.05$) and brisket ash ($r = 0.43$, $P<0.05$). As a whole, chemical composition of the meat in the back joint showed the highest correlation coefficients with the corresponding parameters in the carcass, and may be used as a good predictor of carcass composition in these breeds. Regression analysis of the data indicated that percentages of fat and protein in back meat accounted for about 65% of total variation in carcass meat fat and protein.

Key words: Fat-tailed sheep, Carcass, Meat composition, Mehraban, Ghezel

Introduction

There is a need to reduce the fat content of the carcasses of meat-producing species, as consumers in many countries are demanding less fat in their meat, mainly for reasons of the perceived benefits to health (Allen, 1990). Production of excess fat in carcass is also inefficient in terms of energy resources required (Cameron and Bracken, 1992). These have motivated research for finding ways of producing carcasses with lower levels of fat (Allen, 1990). One problem in these researches is determining carcass/body composition of animals. Other major applications of accurate body composition in animal production include animal breeding programs for meat production, scientific experimentation on metabolic efficiency, growth and carcass quality characters.

Several points should be considered when estimating carcass composition including the ease, speed and accuracy of measurement, the precision with which the measurement can estimate the characteristic, the cost of data collection, and the stability of the prediction equation between different groups of animals (Timon and Bichard, 1965; Kempster *et al*., 1976). Research for development of alternative methods to predict body/carcass composition has been conducted for decades and their application in many countries seems to be limited, because of expense (Swensen *et al*., 1998).

One of the parameters that determine the total cost of a technique is the necessity to destroy a part of the carcass (de Campeneere *et al*., 1999). The physical or chemical composition of a sample joint of the carcass might provide a useful and more economical predictor of whole carcass composition (Hankins, 1947; Kirton and Barton, 1962; Field *et al*., 1963) but it is not yet known which part of the carcass (on the basis of chemical composition) is most closely related to the whole. Swensen *et al*. (1998) suggested that chemical composition of cuts was a better predictor of chemical composition of the side in swine than dissectible components of the same cuts, with the exception of the ham.

The relationships between physical component (fat and lean meat) of carcass cuts and whole carcass have been shown in several studies (Evans and Kempster, 1979; Kempster *et al*., 1986; El Karim *et al*., 1988; Cameron, 1992; Swensen *et al*., 1998; Argüello *et al*., 2001).

The objectives of the present experiment were to study the relationships between chemical composition of carcass cuts and whole carcass in two Iranian breeds of sheep (Ghezel and Mehraban) and to determine the effect of two feeding levels on these relationships. The occasional studies conducted on the chemical composition of meat in Iranian sheep have employed different individual cuts, but the most appropriate cut has not been established for any sheep breed as yet. In some studies the soft tissue from one side of the carcass has been minced for evaluation of carcass chemical composition, but this decreases the carcass value and is labour-intensive and uneconomical.

Materials and Methods

This investigation was carried out by using 48 randomly selected 9-month-old ram lambs of Ghezel and Mehraban (24 rams per breed), arranged as a 2 × 2 factorial experiment with two breeds (Ghezel and Mehraban) and two feeding levels, in a completely randomized design. The lambs were randomly allotted into two groups. There were 12 Ghezel and 12 Mehraban ram lambs in each group. The ration contained 55% alfalfa hay and 45% barely; the animals were supplied with water and salt lick *ad libitum*. The ration consisted of (dry matter basis) 2.45 Mcal metabolizable energy per kg, 13.1% crude protein (CP), 0.71% calcium and 0.29% phosphorus. Feeding levels were selected to obtain an average daily gain (ADG) of either 150 or 300 g (NRC, 1985).

At the start of the experiment, lambs were weighed and after a feeding period of 80 days were slaughtered. Live weight (LW) was recorded prior to slaughter, after withdrawing feed and water for 18 hrs. Hot carcass weight was determined on the day of slaughter. Perinephric, pericardial, gastrointestinal and pelvic fats were removed and weighed separately. Gut fill was determined by weighing the gastrointestinal tract, before and after removal of its contents, and calculated by the difference. Empty body weight (EBW) was then determined as slaughter LW minus gut fill.

The carcass was kept in a cold room (5ºC) for 24 hrs and the cold carcass weight was determined. Fat-tail was removed and weighed. Fat depth over carcass was measured with a caliper at the cross section of the 12th and 13th ribs at 4 points and the values were averaged as a measure of subcutaneous fat depth. The carcass was then split into the right and left sides, the right side was cut into the leg, shoulder, neck, brisket, flap and back joints (Farid, 1989), and each cut was weighed separately. The cuts were then dissected into the bone and meat and were weighed separately. The dissected meat of each cut was minced two times and thoroughly hand-mixed.

For determination of the chemical composition of meat (CP, crude fat, DM and ash) of the cuts, a sample of approximately 50 g was taken from each cut, and for determination of the chemical composition of carcass meat, 10% of the meat of each cut was sampled and hand-mixed thoroughly with the samples from other cuts, and then a sample of approximately 50 g was taken from the mixed product. The samples were kept at -20°C until analysis for chemical composition.

CP, fat (ether extract), DM and ash were determined by Kjeldahl (Buchi 315, Denmark), Suxhelt (Buchi 810, Denmark), oven drying and burning the sample in an electric furnace, respectively (AOAC, 1975). Statistical analyses were performed by using the SAS (SAS, 1996) for Windows Program on a personal computer. The effects of breeds (Ghezel and Mehraban) and feeding levels (high and low) were included in the models. Body weight was included in the models as covariate. Correlation coefficients between carcass and cuts measurement were also determined. Regression equations were derived by using the stepwise procedure, with the chemical composition of whole carcass and cuts as dependent and independent variables, respectively.

Results

Effects of breed, feeding level and their interaction on the composition of meat from various cuts and the whole carcass were not significant (Tables 1, 2 and 3). However, several other attributes were significantly affected by either the breed or feeding level. Ghezel sheep had a significantly heavier (P<0.04) EBW (63.5 ± 9.6 kg) than Mehraban (57.9 ± 9.9 kg). ADG of Ghezel was significantly (P<0.01) higher than for Mehraban (270 ± 66 vs. 233 ± 65 g). Conversely, Ghezel rams had lower subcutaneous fat depth than Mehraban (7.6 ± 1.65 vs. 8.3 ± 2.43 mm; P<0.01). Lambs on the high feeding level had a significantly higher ADG (P<0.01). The higher level of feeding resulted in a considerable increase in the amount of fat around the gastrointestinal tract (75%), around kidneys (114%) and in the pelvic cavity (170%) as compared with the lower level of feeding. Tail weight was not significantly different between breeds, but as expected, higher level of feeding resulted in heavier tail weights compared with the lower feeding level (7.0 ± 2.0 vs. 5.5 ± 1.7 kg; P<0.001). Subcutaneous fat depth was slightly greater (P<0.01) for Mehraban (8.34 ± 2.43 mm) than in Ghezel (7.64 ± 1.65 mm), but was not affected by the feeding level.

Correlation coefficients of the chemical composition of meat in cuts with the chemical composition of total carcass meat in Ghezel and Mehraban sheep are shown in Tables 4 and 5, respectively. Tail weight was only significantly (P<0.01) correlated with subcutaneous fat depth in both Ghezel (r = 0.65) and Mehraban (r = 0.54). Flap weight in Ghezel was the only chemical attribute that showed a small correlation with subcutaneous fat depth (r = 0.40, P<0.05). Protein and fat yield (kg) of the

Table 1: Feedlot performance and chemical composition of whole carcass meat in Ghezel (n = 24) and Mehraban (n = 24) sheep on high (H) or low (L) feeding levels (Mean ± SD)

Parameter	Feeding level	Ghezel	Mehraban
Initial body weight (kg)	L	49.15 ± 9.77	44.57 ± 9.30
	H	48.98 ± 9.24	46.33 ± 8.40
Slaughter weight (kg)	L	67.13 ± 11.46	59.17 ± 9.89
	H	74.13 ± 7.58	69.00 ± 8.16
Average daily gain (g per day)	L	224.4 ± 54.2	182.5 ± 22.9
	H	314.4 ± 43.9	283.3 ± 53.0
Cold carcass weight (kg)	L	35.09 ± 6.34	31.20 ± 5.37
	H	39.08 ± 5.61	36.61 ± 4.75
Empty body weight (kg)	L	60.23 ± 10.60	53.23 ± 9.65
	H	66.85 ± 7.52	62.51 ± 8.01
Carcass DM (%)	L	38.64 ± 4.42	39.44 ± 4.01
	H	39.58 ± 2.16	40.69 ± 1.78
Carcass CP in DM (%)	L	39.17 ± 5.31	37.91 ± 5.14
	H	40.01 ± 2.36	37.45 ± 3.05
Carcass fat in DM (%)	L	53.60 ± 7.63	56.81 ± 5.49
	H	54.73 ± 2.05	56.21 ± 4.12
Carcass ash in DM (%)	L	1.98 ± 0.15	1.90 ± 0.18
	H	1.93 ± 0.21	1.86 ± 0.22

Feed was allocated to obtain an average daily gain of 150 and 300 g for L and H, respectively (NRC, 1985)

Table 2: Chemical composition of meat from leg, shoulder and back in Ghezel (n = 24) and Mehraban (n = 24) sheep on high (H) or low (L) feeding levels (Mean ± SD)

Parameter	Feeding level	Ghezel	Mehraban
Leg DM (%)	L	35.21 ± 2.48	35.65 ± 3.06
	H	36.38 ± 1.99	36.61 ± 4.28
Leg CP in DM (%)	L	44.24 ± 4.57	43.53 ± 4.00
	H	44.96 ± 4.47	43.87 ± 5.44
Leg fat in DM (%)	L	44.04 ± 5.41	49.76 ± 6.83
	H	48.69 ± 4.58	49.10 ± 8.69
Leg ash in DM (%)	L	2.01 ± 0.17	1.92 ± 0.24
	H	1.92 ± 0.27	1.94 ± 0.25
Shoulder DM (%)	L	35.02 ± 3.55	37.60 ± 3.32
	H	35.99 ± 2.56	38.12 ± 2.38
Shoulder CP in DM (%)	L	43.66 ± 6.23	41.91 ± 6.36
	H	40.86 ± 4.28	39.70 ± 2.94
Shoulder fat in DM (%)	L	49.33 ± 7.54	51.14 ± 9.54
	H	52.35 ± 6.12	54.65 ± 3.97
Shoulder ash in DM (%)	L	2.03 ± 0.20	1.93 ± 0.19
	H	2.11 ± 0.29	1.97 ± 0.39
Back DM (%)	L	41.72 ± 7.03	43.56 ± 7.45
	H	43.62 ± 5.50	44.09 ± 3.60
Back CP in DM (%)	L	33.42 ± 9.90	30.64 ± 8.19
	H	35.90 ± 5.34	32.51 ± 3.03
Back fat in DM (%)	L	59.50 ± 11.12	61.58 ± 9.55
	H	58.39 ± 6.02	61.06 ± 4.02
Back ash in DM (%)	L	1.89 ± 0.50	2.14 ± 0.49
	H	2.09 ± 0.44	1.88 ± 0.40

Feed was allocated to obtain an average daily gain of 150 and 300 g for L and H, respectively (NRC, 1985)

Table 3: Chemical composition of meat from brisket, flap and neck in Ghezel (n = 24) and Mehraban (n = 24) sheep on high (H) or low (L) feeding levels (Mean ± SD)

Parameter	Feeding level	Ghezel	Mehraban
Brisket DM (%)	L	47.34 ± 4.03	48.84 ± 3.74
	H	47.77 ± 2.93	49.65 ± 2.49
Brisket CP in DM (%)	L	24.69 ± 3.33	24.72 ± 3.26
	H	25.19 ± 2.51	23.28 ± 2.92
Brisket fat in DM (%)	L	68.89 ± 4.11	70.47 ± 3.59
	H	70.00 ± 4.13	72.78 ± 2.79
Brisket ash in DM (%)	L	1.19 ± 0.16	1.18 ± 0.21
	H	1.35 ± 0.13	1.23 ± 0.28
Flap DM (%)	L	47.72 ± 2.53	48.26 ± 4.82
	H	48.73 ± 3.80	47.93 ± 5.18
Flap CP in DM (%)	L	24.34 ± 2.44	24.73 ± 3.39
	H	24.72 ± 2.04	23.46 ± 2.89
Flap fat in DM (%)	L	70.25 ± 3.43	70.88 ± 4.43
	H	69.67 ± 3.67	72.50 ± 3.26
Flap ash in DM (%)	L	1.27 ± 0.19	1.30 ± 0.15
	H	1.27 ± 0.14	1.25 ± 0.25
Neck DM (%)	L	32.56 ± 3.03	32.80 ± 3.00
	H	34.94 ± 2.89	34.49 ± 1.94
Neck CP in DM (%)	L	50.19 ± 3.83	48.25 ± 6.00
	H	49.65 ± 3.86	49.49 ± 3.99
Neck fat in DM (%)	L	40.76 ± 6.10	42.33 ± 6.47
	H	41.32 ± 4.24	41.81 ± 4.02
Neck ash in DM (%)	L	1.99 ± 0.27	1.92 ± 0.34
	H	2.07 ± 0.35	2.02 ± 0.17

Feed was allocated to obtain an average daily gain of 150 and 300 g for L and H, respectively (NRC, 1985)

Table 4: Pearson's correlation coefficients between chemical composition of meat from carcass cuts and whole carcass in Ghezel sheep

Parameter	Carcass DM	Carcass CP in DM	Carcass fat in DM	Carcass ash in DM
Leg DM	0.66***	-0.58**	0.60**	0.20
Shoulder DM	0.81***	-0.76***	0.72***	-0.33
Brisket DM	0.78***	-0.74***	0.69***	-0.34
Flap DM	0.58**	-0.42*	0.50*	-0.18
Back DM	0.74***	-0.68***	0.63***	-0.10
Neck DM	0.48*	-0.32	0.27	-0.18
Leg CP in DM	-0.54**	0.73***	-0.61**	0.31
Shoulder CP in DM	-0.73***	0.72***	-0.62**	0.36
Brisket CP in DM	-0.54**	0.62**	-0.54**	0.31
Flap CP in DM	-0.43*	0.47*	-0.51*	-0.08
Back CP in DM	-0.71***	0.80***	-0.70***	0.11
Neck CP in DM	-0.29	0.41*	-0.19	0.08
Leg fat in DM	0.50*	-0.58**	0.47*	-0.37
Shoulder fat in DM	0.74***	-0.75***	0.71***	-0.41*
Brisket fat in DM	0.59**	-0.63***	0.52**	-0.35
Flap fat in DM	0.29	-0.26	0.15	0.17
Back fat in DM	0.79***	-0.81***	0.76***	-0.14
Neck fat in DM	0.44*	-0.57**	0.32	-0.20
Leg ash in DM	-0.16	-0.06	0.02	0.40
Shoulder ash in DM	0.06	0.11	-0.10	0.36
Brisket ash in DM	0.01	0.21	-0.13	0.23
Flap ash in DM	0.01	-0.08	0.14	0.18
Back ash in DM	-0.29	0.35	-0.39	0.28
Neck ash in DM	-0.48*	0.36	-0.39	0.05

*P<0.05; **P<0.01 and ***P<0.001

Table 5: Pearson's correlation coefficients between chemical composition of meat from carcass cuts and whole carcass in Mehraban sheep

Parameter	Carcass DM	Carcass CP in DM	Carcass fat in DM	Carcass ash in DM
Leg DM	0.50*	-0.47*	0.40	-0.48*
Shoulder DM	0.48*	-0.50*	0.35	-0.17
Brisket DM	0.68***	-0.62**	0.61**	-0.14
Flap DM	0.37	-0.26	0.32	-0.09
Back DM	0.84***	-0.87***	0.77***	-0.13
Neck DM	0.40	-0.37	0.14	0.10
Leg CP in DM	-0.44*	0.59**	-0.54**	0.40
Shoulder CP in DM	-0.50*	0.47*	-0.39	0.18
Brisket CP in DM	-0.39	0.42*	-0.35	0.05
Flap CP in DM	-0.41*	0.24	-0.32	0.29
Back CP in DM	-0.70***	0.80***	-0.78***	0.20
Neck CP in DM	-0.12	0.26	-0.05	-0.19
Leg fat in DM	0.38	-0.52**	0.57**	-0.36
Shoulder fat in DM	0.54**	-0.53**	0.53**	-0.30
Brisket fat in DM	0.53**	-0.50*	0.45*	0.02
Flap fat in DM	0.51*	-0.33	0.46*	-0.29
Back fat in DM	0.68***	-0.78***	0.84***	-0.27
Neck fat in DM	0.05	-0.12	-0.05	0.17
Leg ash in DM	0.27	-0.33	0.46*	0.29
Shoulder ash in DM	-0.21	0.00	-0.02	0.58**
Brisket ash in DM	-0.12	-0.21	0.02	0.43*
Flap ash in DM	-0.18	0.07	-0.12	-0.15
Back ash in DM	-0.18	-0.07	0.00	0.49*
Neck ash in DM	0.32	-0.06	0.08	0.08

*P<0.05; **P<0.01 and ***P<0.001

carcass meat was significantly correlated with the tail weight and subcutaneous fat depth in both breeds, but the coefficients were larger for Ghezel sheep.

CP percentages of the leg, shoulder, brisket, flap and back meat showed significant and positive correlations with carcass meat CP, and negative correlations with carcass meat DM and fat in Ghezel sheep. Neck meat CP was only significantly correlated with of carcass meat CP. In Mehraban sheep, the percentage of CP in the leg, shoulder, brisket, flap and back meat showed negative and significant correlations with carcass meat DM. The percentage of CP in all joints, except flap and neck, showed significant and positive correlations with carcass meat CP. The percentage of CP in the leg and back meat showed significant and negative correlations with carcass meat fat.

Fat percentage in the leg, shoulder, brisket and back meat was significantly and positively correlated with carcass meat DM and fat, and negatively correlated with carcass meat CP in Ghezel sheep. Neck meat fat showed significant and positive correlation with carcass meat DM and negative correlation with carcass meat CP. In Mehraban sheep, the percentage of fat in shoulder, brisket and back meat showed significant and positive correlations with the percentage of carcass meat DM and fat, and negative correlations with carcass meat CP. The fat percentage in leg meat was positively correlated with carcass fat and negatively correlated with carcass CP.

In Ghezel lambs, shoulder meat DM and back meat fat had the highest correlation coefficients with the carcass meat DM ($r = 0.81$ and 0.79, respectively; $P<0.001$). In Mehraban, back meat DM and CP had the highest coefficients with carcass meat DM, ($r = 0.84$ and -0.70, respectively; $P<0.001$). Back meat fat and CP showed the highest correlation with carcass meat CP in Ghezel lambs ($r = -0.81$ and 0.80, respectively; $P<0.001$). In Mehraban lambs, back meat DM and CP showed the highest correlations with carcass meat CP ($r = -0.87$ and 0.80, respectively; $P<0.001$). Back meat fat and shoulder meat DM in Ghezel, and back meat fat and CP in Mehraban showed the highest correlations with carcass meat fat (for Ghezel $r = 0.76$ and 0.72, $P<0.001$ and for Mehraban $r = 0.84$ and -0.78, $P<0.001$).

Regression equations of chemical composition of carcass meat for Ghezel lambs were as follows (CP, fat and ash percentages are on DM basis):

DM (%) = 44.242 + 0.191 back fat (%) – 0.251 shoulder CP (%) – 2.872 neck ash (%)

($R^2 = 0.801$, RSD = 1.639)

Back fat, shoulder CP and neck ash accounted for 63.05, 10.93 and 6.14% of the variation in carcass meat DM, respectively.

CP (%) = –12.978 – 0.204 back crude fat (%) + 0.805 leg CP (%) + 0.216 shoulder CP (%) + 0.401 leg fat (%)

($R^2 = 0.927$, RSD = 1.202)

Back fat, leg CP, shoulder CP and leg fat accounted for 65.17, 20.93, 3.42 and 3.16% of the variation in carcass meat CP, respectively.

Crude fat (%) = 52.405 + 0.385 back fat (%) – 0.470 leg CP (%)

($R^2 = 0.697$, RSD = 3.166)

Back fat and leg CP accounted for 57.35 and 12.34% of the variation in carcass meat fat, respectively.

Ash (%) = 2.501 – 0.011 shoulder fat (%)

($R^2 = 0.171$, RSD = 0.168)

Regression equations of chemical composition of carcass meat for Mehraban lambs were as follows (CP, fat and ash percentages are on DM basis):

DM (%) = 26.603 – 0.391 back CP (%) + 0.307 flap fat (%) + 0.188 neck fat (%) – 2.060 back ash (%)

($R^2 = 0.809$, RSD = 1.491)

Back CP, flap fat, back ash and neck fat accounted for 49.51, 16.81, 8.52 and 6.10% of the variation in carcass meat DM, respectively.

CP (%) = 13.832 + 0.444 back CP (%) + 0.684 leg CP (%) + 0.225 leg fat (%) – 0.369 brisket fat (%) – 3.973 brisket ash (%)

($R^2 = 0.879$, RSD = 1.348)

Back CP, leg CP, leg fat, brisket fat and brisket ash accounted for 63.44, 15.17, 4.40, 2.67 and 2.20% of the variation in carcass meat CP, respectively.

Crude fat (%) = –14.339 + 0.400 back fat (%) + 0.422 flap fat (%) + 0.233 leg fat (%) + 2.257 back ash (%)

($R^2 = 0.883$, RSD = 1.793)

Back fat, flap fat, leg fat and back ash accounted for 71.35, 7.49, 5.61 and 3.80% of the variation in carcass meat fat, respectively.

Ash (%) = 1.156 + 0.372 shoulder ash (%)

($R^2 = 0.334$, RSD = 0.162)

Discussion

The higher feeding level resulted in an ADG of about 300 g as compared with 204 g for the lower feeding level. The levels of feeding had been chosen to result in 300 and 150 g weight gain per day, according to the NRC (1985) recommendations for thin-tailed sheep, as there are no data available for the fat-tailed sheep. It seems that for practical purposes these recommendations can also be used for these fat-tailed sheep.

Lambs on the higher feeding level deposited more fat around the internal organs and in the tail, but the relative increases were not the same among various fat depots. The chemical composition of meat in individual cuts and in the whole carcass and the subcutaneous fat depth were not affected by the feeding level, therefore, the higher energy intake increased in the amount of fat in depots which are regarded as waste fat after slaughter. This results in food wastage and increases the production cost. These findings substantiated the findings in the thin-tailed sheep. Under conditions of very controlled feeding, carcass fatness can be manipulated in ruminants (Butler-Hogg and Johnsson, 1986), but under practical feeding situations this is more difficult because of the fibrous nature of feeds allowing a limited range of energy input and the equalizing nature of the fermentation process (Kirton *et al*., 1981; Bass *et al*., 1990). Burton and Reid (1969) found that sheep body composition was not related to prior energy intake, only slightly associated with age, but was chiefly associated with body weight. Similarly, carcass composition is said to be weight-dependent and largely uninfluenced by age or nutritional regime (Lawrie, 1998). Osborne *et al*. (1961) and Ray and Mandigo (1966) reported that the carcass of lambs fed high energy diets contained more fat than lambs fed low energy diets. However, Ringkob *et al*. (1964) and Burton and Reid (1969) found that within genetically similar groups, the level of dietary energy did not significantly affect the fat content of wether lamb carcasses being evaluated on a weight constant basis. Murray and Slezacek (1976) showed that in lambs, at the same dissected side weight, the amount of muscle, bone, connective tissue and total side fat was similar for three different feeding levels. Animals fed ad libitum had more subcutaneous and less intermuscular fat than animals on restricted feeding. While, Jones *et al*. (1983) found that the dietary energy intake had a small but statistically significant effect on carcass muscle distribution in sheep, Murray and Slezacek (1980) reported no effects of nutrition on muscle distribution. In the study of Crouse *et al*. (1978) dietary energy had little effect on carcass composition; percentage of kidney and pelvic fat greatly increased with increases in energy density; however, no differences in fat thickness were observed.

As far as the simple correlation coefficients show percentage of the back meat CP is the best indicator of the total carcass meat CP, with a coefficient of 0.80 for both breeds. Similarly, the correlation coefficients show that the percentages of fat and DM in the meat from the back joint can better predict the corresponding parameters in the carcass meat. In general, the water content of carcass meat is negatively correlated to fat content, and positively associated with muscle tissue and protein content (Varnam and Sutherland, 1995). DM percentage of carcass meat correlates positively with the fat percentage and negatively with the protein percentage. There is also a negative correlation between the percentages of carcass fat and protein (Kempster *et al*., 1982). Results of the present experiment are consistent with these findings. Meat DM of carcass cuts was positively correlated with carcass meat DM and fat, and negatively correlated with carcass meat CP. Similarly, meat CP percentages of cuts were positively correlated with carcass meat CP and negatively correlated with the carcass meat DM and fat. In an experiment carried out by Kirton and Barton (1962), percentages of water, protein and fat in the leg, loin and fore parts of the lamb carcass were correlated with the corresponding composition of whole carcass. These authors also reported that the loin and rib joints were the most satisfactory parts for prediction of carcass chemical composition. The correlation coefficients between the tail weight and various carcass attributes are in general agreement with previous data on a group of the same sheep breeds that were 18-month-old (Zamiri and Izadifard, 1997).

The results of this experiment showed that chemical composition of meat of the back joint was the best predictor of carcass meat composition in these Iranian sheep. This is consistent with the findings of Hammond *et al*. (1983) and McMeekan (1941) who reported that the loin and back joints, being the latest developing parts of the carcass, were the best regions for prediction purposes in thin-tailed sheep. They found that the late-maturing regions provide better prediction than early-maturing regions. There is, however, no fundamental mathematical reason why the relation between dissectible tissue in a late-developing region and whole carcass is stronger than that between early-maturing region and whole carcass (Fisher, 1990).

The findings presented here substantiate the belief that where small differences are expected in experimentally conditioned animals, then it is reasonable to analyse whole carcass or at least one of the sides. This contention is especially valid where few animals are used per group. On the other hand, use of whole carcass or sides for evaluation of carcass composition is costly, time-consuming and reduces carcass value. However, analysis of sample cuts provides a measure of carcass composition with reasonable accuracy. For many investigations, the information obtained by employing this technique may be sufficiently precise to justify its use.

Among different carcass cuts, chemical composition of the back meat showed the highest correlations with those of the carcass, and can be used as a good predictor of whole carcass composition in Ghezel and Mehraban lambs. Because carcass composition is slightly dependent on age and is largely weight-dependent (Lawrie, 1998), there is a need to determine the effect of different ages and weights on carcass composition, and also on distribution of chemical composition (water, protein, fat and ash) between different carcass cuts in these Iranian sheep breeds.

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