

A Comparison of Carcass Chemical Composition of Najdi and Naeimi Ram Lambs Slaughtered at 50kg Body Weight*

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ABSTRACT. Fifteen ram lambs from each of Najdi and Naeimi sheep breeds were slaughtered at 50 kg live weight. The objective was to examine the effects of breed on the chemical composition of the carcasses and the distribution of various chemical constituents in wholesale cuts. The results showed that the differences between boneless weights for each of leg, loin, shoulder and breast cuts from Najdi and Naeimi were not statistically different. Najdi carcasses had heavier ($p < 0.01$) rack and flank cuts than those of Naeimi. However, in each cut, Najdi contained more ($p < 0.01$) separable and chemical fats and correspondingly less ash and moisture contents than that of Naeimi. On the other hand, Najdi nad Naeimi had similar amounts of protein in each studied boneless wholesale cut. In general, the flank cut had a higher ($p < 0.01$) percentage separable fat and lower percentages of chemical fat, protein, ash and moisture than the other cuts. On the contrary, the shoulder cut had the lowest percentage separable fat and the highest ($p < 0.01$) percentage moisture compared to the other cuts.

The R^2 values for the best equations for prediction of various chemical compositions of Najdi and Naeimi whole carcasses ranged from 0.43 to 0.72 and from 0.56 to 0.98, respectively.

The intrinsic value of a lamb is a function of its genetic potential to grow efficiently (Leymaster and Jenkins 1985) and to produce a quality lean tissue at the least possible cost (Kempster *et al.* 1982 and Dahmen *et al.* 1985). Several studies, however, have indicated that wholesale cuts of various breeds of sheep differ in value because they differ in palatability and in chemical composition (Lirette *et al.* 1984 and Dahmen *et al.* 1985). Data relating to breed differences and changes in cut composition are needed to guide sheep producers in the choice of breeds (Seebeck 1968 and Notter *et al.* 1983). On the other hand, there is a dearth of information concerning the chemical composition and the distribution of various

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chemical constituents in Najdi and Naeimi carcasses. Such information is essential for developing a comprehensive understanding of carcass characteristics of the most prevailing breeds in Saudi Arabia (Abouheif *et al.* 1985).

The objective of this study was to evaluate the carcass and wholesale-cut composition of Najdi and Naeimi ram lambs slaughtered at 50 kg live body weight. Also, from the physical separation and the chemical composition data, equations were developed to predict whole carcass chemical composition.

Materials and Methods

Thirty ram lambs representing equal numbers of Najdi and Naeimi sheep were used for this study. Animals were purchased as yearlings from a commercial farm near Al-Kharj area, Saudi Arabia, weighing between 46.2 and 51.8 kg live body weights. All lambs were raised together under similar environmental, nutritional and management conditions. Additional details of sheep husbandry were presented by Abouheif *et al.* (1987).

The Najdi and Naeimi ram lambs were fasted for 24 hr before slaughter; however, water was available at all times. After slaughter, the carcasses were allowed to chill at 5°C and suspended by the Achilles tendon for 24 hr. After chilling, the cold carcass weights were recorded and the total kidney, pelvic and heart fats were removed and weighed. Carcasses were then fabricated into standard wholesale leg, loin, rack, shoulder, breast and flank cuts by procedure described by Romans and Ziegler (1974). In addition, the neck and the fat tail were removed from the carcass following the procedure outlined by Abouheit *et al.* (1987).

Each wholesale cut was separated into boneless cut. The boneless wholesale cut was further trimmed of all subcutaneous and most intermuscular fats. The combined subcutaneous and intermuscular fat weights of each cut were used as the estimate of separable fat weight. The lean from each cut was ground through a 0.3-cm plate, mixed and reground, and five grab samples were taken from each separate boneless wholesale-cut. Grab samples for each cut were remixed, and a 100-g sample was placed in an airtight, sealed plastic bag and frozen at - 25°C for chemical analysis. Chemical analysis was determined separately on each wholesale cut from Najdi and Naeimi. Moisture, chemical fat (intramuscular and some inseparable intermuscular fats), protein ($N \times 6.25$) and ash were measured in duplicate using procedures outlined by AOAC (1980).

Statistical analysis performed on the data included averages, correlations and stepwise multiple regression. The stepwise regression technique was restricted in

that only variables that had an effect with a probability of less than 0.15 were used in the equations. The chemical compositions of lean from the boneless wholesale cuts (leg, loin, rack, shoulder, breast or flank) were used as independent variables to develop equations to predict the chemical composition (fat, protein, moisture or ash) on the boneless whole carcass. All analysis were accomplished by the used of the statistical analysis system (SAS 1982).

Results and Discussion

Carcass chemical composition is often presented as a percentage of carcass weight; however, Craddock *et al.* (1973) have shown that less variation is accounted for by an analysis of percentages than one of actual weights. Other workers have also warned that analyses based on percentages can be misleading (Seebeck 1968 and Sents *et al.* 1982). Therefore, no analyses were conducted on the percentage values from this study, but they are presented for comparative and discussion purposes. Weights and percentage chemical compositions are presented in Table 1 for each boneless cut from Najdi and Naeimi ram lamb carcasses. The average percentages of boneless Najdi and Naeimi leg cuts were 29.1 and 30.8 of total boneless carcasses, respectively, followed by boneless shoulder, breast, loin, rack and flank cuts; the corresponding percentages were 20.1 and 19.9, 14.5 and 14.4, 7.7 and 8.7, 7.5 and 5.5, and 5.7 and 4.4 respectively. With the exception of boneless weights of rack and flank cuts, the differences between boneless weights of various studied wholesale cuts from Najdi and Naeimi carcasses were not statistically different. However, Najdi carcasses had heavier ($p < 0.01$) boneless rack and flank cuts than those cuts produced from Naeimi carcasses. Breed of ram lambs did not alter the percentages separable fat, protein and moisture in boneless wholesale leg and loin cuts, whereas the percentages chemical fat and ash in boneless wholesale leg cut were altered ($p < 0.01$) by the breed of ram lambs. Within each of boneless wholesale rack, shoulder, breast and flank cut, the percentages separable fat, chemical fat, ash and moisture were also altered ($p < 0.01$) by the breed of ram lambs. In each cut, Najdi carcasses contained more separable and chemical fats and correspondingly less ash and moisture contents than in Naeimi carcasses. The results also revealed that Najdi and Naeimi carcasses had similar amounts of protein in each studied boneless cut. The latter findings are in agreement with those results by Lirette *et al.* (1984) who indicated that breeds of sheep did not affect the chemical composition of the muscular portion within each retail cut. When comparing the percentage chemical compositions in various boneless cuts and irrespective of breed of sheep, flank cut had more ($p < 0.01$) separable fat and less chemical fat, protein, ash and moisture than the other boneless cuts. On the contrary, the shoulder cut had the lowest percentage separable fat and the highest ($p < 0.01$) percentage moisture than the other studied cuts. In general, cuts with more fat had less moisture than did cuts with less fat (Notter *et al.* 1983).

Table 1. Weights and percentage chemical compositions in boneless wholesale cuts from Najdi (N=15) and Naeimi (N=15) carcasses.

Boneless cut	Chemical composition (%)					
	Wt., kg	S. fat ^a	Ch. fat ^a	Protein	Ash	Moisture
Leg:						
Najdi	5.48 ^b	20.51 ^g	8.50 ^{cc}	14.45 ^b	2.44 ^{de}	54.10 ^{cd}
Naeimi	5.73 ^b	20.51 ^g	5.86 ^h	13.72 ^b	2.99 ^b	56.92 ^c
Loin:						
Najdi	1.44 ^c	38.24 ^d	7.25 ^{fg}	10.87 ^c	1.90 ^f	41.74 ^f
Naeimi	1.62 ^c	36.93 ^d	6.22 ^{gh}	11.18 ^{cd}	1.99 ^f	43.68 ^f
Rack:						
Najdi	1.42 ^c	27.01 ^c	12.14 ^b	12.23 ^{bcd}	1.99 ^f	46.63 ^c
Naeimi	1.02 ^f	20.57 ^g	8.00 ^{ef}	13.55 ^b	2.47 ^{de}	55.41 ^c
Shoulder:						
Najdi	3.78 ^c	20.37 ^g	11.88 ^b	13.25 ^b	2.28 ^e	52.22 ^d
Naeimi	3.70 ^c	12.46 ^h	9.85 ^{cd}	14.14 ^b	2.74 ^c	60.81 ^b
Breast:						
Najdi	2.72 ^d	26.38 ^e	11.70 ^{bd}	12.35 ^{bcd}	2.00 ^f	47.57 ^c
Naeimi	2.68 ^d	23.18 ^f	9.32 ^c	12.38 ^{bcd}	2.50 ^d	52.62 ^d
Flank:						
Najdi	1.08 ^f	60.48 ^b	5.98 ^h	7.68 ^e	1.24 ^h	24.62 ^h
Naeimi	0.82 ^g	49.46 ^c	3.95 ⁱ	8.71 ^c	1.63 ^g	36.25 ^g

S. fat^a = separable fat; Ch. fat = chemical fat.

b,c,d,e,f,g,h,i Means in the same column with different superscripts differ ($p < 0.01$). All statistical analysis were based on actual weights.

Weights and percentage chemical compositions of whole boneless carcasses from Najdi and Naeimi ram lambs are presented in Table 2. The amounts of separable and chemical fats in relation to the weight of whole boneless carcasses did differ significantly ($p < 0.01$) between Najdi and Naeimi rams, indicating that Najdi ram lambs are fatter sheep than their Naeimi counterpart. The results agree with the previous finding by Abouheif *et al.* (1987) who found that Najdi sheep attained higher percentage fat deposition at 50 kg live weight than did Naeimi sheep. These differences, however, showed the expected trend toward greater fatness at the same weight in small early maturing breeds. Similar results were also reported by Notter *et al.* (1983) and Lirette *et al.* (1984) who found that the weight

Table 2. Weight and percentage chemical composition in boneless carcasses from Najdi (N=15) and Naeimi (N=15) ram lambs.

Character	Najdi		Naeimi	
	Wt.,kg	%	Wt.,kg	%
Boneless carcass weight	18.820	100.00	18.630	100.00
Total carcass fat ^c	8.674 ^a	46.09	7.696 ^b	41.31
S. fat	4.200 ^a	22.32	3.456 ^b	18.55
Ch. fat	1.574 ^a	8.36	1.180 ^b	6.33
KPHT fat	2.900	15.41	3.060	16.43
Total carcass protein	2.030	10.79	2.038	10.94
Total carcass ash	0.344	1.83	0.408	2.19
Total carcass moisture	7.772 ^a	41.29	8.488 ^b	45.56

^{ab}Means in the same row with different superscripts differ ($p < 0.01$).

S. fat^c = separable fat; Ch. fat = chemical fat; KPHT fat = kidney, pelvic, heart and tail fats.

at which lambs began the final fattening phase was positively related to the mature size of the breed. The results also showed that breed of lambs influenced the proportions of boneless carcass fat partitioned into separable fat (mainly subcutaneous fat) and other fat depots. If total fat content in carcasses from lambs of equal weight is different, in many cases it would be of value to know where the fat is distributed. Differences in fat partition and distribution are important when defining selection objectives, in studying the rate of body maturation and in studying metabolic efficiency and meat quality (Leymaster and Jenkins 1985). The precise separation of carcass fats have indicated that Najdi had higher proportion of subcutaneous fat, 48.4%, in relation to other carcass fats than in Naeimi carcasses, 44.9%. These results were in accordance with the findings by Field *et al.* (1985) who stated that dissectable subcutaneous fat increases faster than does intramuscular fat as sheep fatten faster. In a similar connection, Berg and Walters (1983) observed that late-maturing cattle tend to have a lower proportion of subcutaneous fat relative to total carcass fat than breeds that matured earlier. On the other hand, the total amounts of kidney, pelvic, heart and tail fats relative to boneless carcass weight did not differ significantly between Najdi and Naeimi ram lambs. Similarly, breed differences in total protein and total ash contents were not significant. These results were in agreement with those findings by Notter *et al.* (1983) and Lirette *et al.* (1984). Consequently, the deposition of protein relative to fat was positively related to maturity rate in Najdi and Naeimi sheep. It should be mentioned that the observed differences between Najdi and Naeimi are quite optimistic because of their differences in genetic structure.

Table 3. Correlation coefficients^a between carcass chemical compositions and the corresponding chemical compositions in each boneless wholesale cut of Najdi (N=15) and Naeimi (N=15) ram lambs.

Boneless cut ^b	Boneless carcass				
	Wt.	Fat	Protein	Moisture	Ash
Leg	0.278 0.893**	0.354 0.829**	0.327 0.834**	0.340 0.898**	0.322 0.680**
Loin	0.656** 0.640**	0.670** 0.712**	0.686** 0.551*	0.661** 0.600*	0.674** 0.548*
Rack	0.379 0.906**	0.444 0.932**	0.402 0.808**	0.341 0.900**	0.218 0.910**
Shoulder	0.699** 0.689**	0.762** 0.679**	0.770** 0.703**	0.739** 0.691**	0.688** 0.689**
Breast	0.221 0.761**	0.583* 0.666**	0.522* 0.707**	0.471 0.782**	0.545* 0.771**
Flank	0.375 0.313	0.332 0.424	0.444 0.352	0.408 0.250	0.374 0.235

^aAll calculated correlation coefficients were based on actual weights.

^bUpper line = Najdi; Lower line = Naeimi.

* $p < 0.05$; ** $p < 0.01$.

Correlation coefficients between each chemical composition in boneless whole carcass and the corresponding chemical composition in each boneless wholesale cut were calculated and presented in Table 3. Significant positive correlation coefficients ($p < 0.01$) existed between various chemical compositions of boneless carcass and the corresponding chemical compositions in boneless shoulder and loin cuts from Najdi ram lambs, and between boneless carcass chemical compositions and the corresponding compositions in rack, leg, breast, shoulder and loin ($p < 0.05$) cuts from Naeimi sheep. Similar trends of relationships were also obtained between boneless carcass weight with various boneless wholesale cuts in Najdi and Naeimi sheep.

The relationships between boneless weight, total weight of protein, total weight of fat, total weight of ash and total weight of moisture in each boneless wholesale cut (X's) and the corresponding compositional weights in boneless carcass (Y) are expressed for both Najdi and Naeimi ram lambs by equations presented in Tables 4 and 5, respectively. Various statistics can be used to

determine "best" fitting equations for particular situations. Therefore, the coefficients of determination (R^2) are proved in some cases to be a convenient statistic for identification of the best prediction equation that has the maximum R^2 . Furthermore, Mallows (1973) has proposed a statistic (C_p) related to both R^2 and residual variance to identify the relative contribution of squared true error and squared lack of fit. The usual goal has been to minimize C_p values. R^2 values for the best equations for prediction of various chemical compositions of the Najdi whole carcass ranged from 0.430 to 0.725, indicating that these equations accounted for only 43 to 72% of the variation in the carcass chemical components. On the other hand, the R^2 values for the prediction equations of Naeimi carcass were higher, ranging from 0.560 to 0.980. Although, the equations developed provide a means to accurately estimate carcass chemical masses, the magnitude of the R^2 values were smaller than those obtained by Kempster *et al.* (1982) and Field *et al.* (1985). Therefore, certain carcass trait data had to be included in the prediction equations to provide accuracy needed to make these equations useful experimental tools. Several workers have shown that the wholesale cut composition values are important independent variables to these equations, but without the inclusion of other carcass traits, the accuracy of prediction would have been greatly reduced (Kempster *et al.* 1982 and Field *et al.* 1985).

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Table 4. Regression coefficients for predicting weights^a of carcass chemical compositions from weight of corresponding chemical composition in various Najdi wholesale cuts.

Equation	Dependent variable	R^2	C_p	B_0^b	Regression coefficient		
					Shoulder	Loin	Breast
1	Boneless carcass weight	0.490	3.62	10.22	4.58**		
2		0.694	0.17	9.00	3.55**	4.46*	
1	Total carcass protein	0.594	1.29	1.03	4.10**		
1	Total carcass fat	0.450	4.43	6.39		7.19**	
2		0.573	3.20	4.38		5.61*	4.75
1	Total carcass ash	0.430	4.01	0.11	0.03*		
1	Total carcass moisture	0.547	3.24	4.06	3.79**		
2		0.725	0.04	3.74	2.95**	3.95*	

Weight^a in kg. B_0^b = intercept.

* $p < 0.05$; ** $p < 0.01$.

Table 5. Regression coefficients for predicting weights of carcass chemical compositions from the corresponding weights of chemical compositions in various Naeimi wholesale cuts.

Equation	Dependent variable	R ²	Cp	B ₀ ^a	Regression coefficient				
					Rack	Leg	Breast	Flank	Shoulder
1	Boneless carcass weight, kg.	0.821	33.71	4.59	27.01**				
2		0.928	10.62	1.97	16.08**	2.99**			
3		0.956	6.15	0.67	22.17**	3.05**		-4.29*	
4		0.975	3.88	0.33	17.72**	3.28**		-4.80**	1.17*
1	Total carcass protein, kg.	0.696	2.72	0.66		3.34**			
2		0.822	0.29	0.58		2.58**	2.17*		
1	Total carcass fat, kg.	0.870	6.03	2.95	30.41**				
2		0.916	3.09	1.96	22.88**	3.01*			
1	Total carcass ash, kg.	0.560	6.19	0.10		0.03*			
1	Total carcass moisture, kg.	0.811	39.70	2.38	21.46**				
2		0.941	8.83	1.02	12.54**	2.47**			
3		0.969	3.78	0.32	18.14**	2.51**		-5.51*	
4		0.980	3.01	0.20	15.81**	2.58**		-6.18**	0.67

B₀^a = intercept.

* p < 0.05; ** p < 0.01.

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مقارنة المحتوى الكيميائي لذبائح الحملان النجدي والنعيمي المذبوحة عند وزن جسم ٥٠ كجم

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ذبح في هذه التجربة ١٥ حمل نجدي و ١٥ حمل نعيمي عند وزن جسم مساوي لـ ٥٠ كجم وذلك من أجل مقارنة تأثير السلالة على التركيب الكيميائي وتوزيع هذه المركبات في قطيعات الذبيحة القياسية. وقد أوضحت النتائج أنه لا توجد اختلافات إحصائية بين السلالتين عند مقارنة وزن قطيعات الرجل والقطن والكتف والصدر، بينما كانت هناك اختلافات واضحة بين النجدي والنعيمي في وزن قطيعتي الضلوع والبطن حيث تفوق النجدي على النعيمي. وبصورة عامة كانت الذبائح المنتجة من النجدي محتوية على وزن أعلى في الدهون وأقل في الرماد والرطوبة عن النعيمي. وبالنسبة لمحتوى القطيعات المختلفة من البروتين لم يتضح أن هناك اختلاف إحصائي بين السلالتين. وقد أثبتت الدراسة أيضاً أن قطعية البطن بصورة عامة تحتوي على أعلى نسبة مئوية في الدهون المفصولة وأقل نسبة مئوية في الدهون الكيميائية التي تتخلل العضلات ومن البروتين والرماد والرطوبة بالمقارنة مع باقي القطيعات المنتجة من الذبيحة. وعلى العكس من ذلك فإن قطعية الكتف كانت من أقل القطيعات في النسبة المئوية للدهون المفصولة وأعلىهم في النسبة المئوية للرطوبة بالمقارنة مع باقي القطيعات.