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Relationships Between Live Body and Carcass Measurements and Carcass Components in Omani Sheep

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العلاقة بين قياسات الجسم الحي وقياسات الذبيحة ومكوناتها في الضأن العماني

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خلاصة: تمت تغذية اثنين وثلاثين من الضأن العماني (منها ثمانية ذكور غير مخصية وستة عشر ذكراً مخصياً و ثمان إناث) على عليقة مركزة (١٦٪ بروتين خام) وعشب حشيش الرودس المقطع (٨٪ بروتين خام) من الفطام إلى أن تم ذبحها عند وزن ٢٦ كيلوجراما. استخدمت تحاليل الارتباط والانحدار لتقييم العلاقات بين قياسات الجسم الحي وقياسات جسد الذبيحة مع مكونات الجسم الرئيسية. بصفة عامة كانت هناك علاقات ارتباط موجبة بين وزن الجسم عند الذبح ووزن الجسم الخالي ووزن الذبيحة الدافئ مع وزن العضلات (r^2 = 0.57, 0.59, 0.59) والدهن (r^2 = 0.47, 0.48, 0.68) والعظم (r^2=0.51, 0.44, 0.31) في الذبيحة على التوالي. كانت هناك أيضاً علاقة ارتباط موجبة (r^2 = 0.44 - 0.59) بين القياسات الخطية للجسم الحي والذبيحة مع نسبة العضلات في الذبيحة. كان لسمك الأنسجة فوق الضلع الحادي عشر (GR) معامل ارتباط موجب عال (r^2 = 0.67) مع نسبة الدهن الكلية في الجسم. وكان لوزن معظم العظام والعضلات الفردية معامل ارتباط موجب (r^2 = 0.39 - 0.85) مع نسبة العضلات والعظم في الجسم، ووجد أن هناك معامل ارتباط موجب بين وزن قطعية العنق والكتف (r^2 = 0.62) وقطعية القص والعضد (r^2 = 0.38) وقطعية الفخذ (r^2 = 0.79) والخاصرة (r^2 = 0.45) مع نسبة العضلات الكلية في الجسم. كان لنسبة العضلات في كل قطعيات الذبيحة معامل ارتباط موجب (r^2 = 0.46 - 0.86) مع نسبة العضلات في الذبيحة وكذلك كان لنسبة العظم في كل قطعيات الذبيحة معامل ارتباط موجب (r^2 = 0.45 - 0.90) مع نسبة العظم الكلية للذبيحة. تم إجراء نموذج تحليل حاسوبي ذي ثلاث عوامل (طول الجسم، وعمق الصدر، وطول الرجل) وآخر ذي أربعة عوامل (وزن الذبيحة الدافئ، والعرض عند العرقوب، والعرض عند الأضلع، وسمك الأنسجة فوق الأضلع) يرجع إليها ٨٤٪ و ٧٠٪ من التباين في نسبة العضلات في الذبيحة على التوالي، وأوضحت الدراسة الحالية أن لقياسات جسم الحيوان الحي وقياسات الذبيحة علاقات مهمة مع مكونات الذبيحة في الضأن العماني. هذه العلاقات يمكن استخدامها في التنبؤ بمحتويات الذبيحة في الحيوان الحي وكذلك لتقييم نوعية الذبائح وجودتها.

ABSTRACT: Thirty two Omani sheep including eight intact males, 16 castrated males and eight intact females were fed *ad libitum* a concentrate diet (16% CP) plus chopped Rhodesgrass hay (8% CP) from weaning until slaughter at an average weight of 26 kg. Correlation and regression analyses were carried out to evaluate relationships between live body and carcass measurements with major body components. Generally there were positive correlations between slaughter weight, empty body weight (EBW) and hot carcass weight with total carcass muscle (r^2 = 0.57, 0.59, 0.59), fat (r^2 = 0.47, 0.48, 0.68) and bone (r^2 = 0.51, 0.44, 0.31) contents, respectively. There were also positive correlations (r^2 = 0.44 - 0.59) between linear live body and carcass measurements with carcass muscle content. The depth of tissue over the 11th rib (GR) had a high positive correlation (r^2 = 0.67) with total carcass fat content. The weight of most individual bones and muscles had positive correlations (r^2 = 0.39 - 0.85) with carcass muscle and bone content. There was a positive correlation between weight chuck (r^2 = 0.62), brisket and shank (r^2 = 0.38), leg (r^2 = 0.79) and loin (r^2 = 0.45) carcass cuts with total carcass muscle content. Muscle content in all carcass cuts had a positive correlation (r^2 = 0.46-0.86) with total carcass muscle content. Bone content in all carcass cuts had a high positive correlation (r^2 = 0.45-0.90) with the total carcass bone content. A 3-variable (body length, chest depth and leg length) and a 4-variable (hot carcass weight, hook width, rib width and GR) models were generated which accounted for 84% and 70% of the variation in the total muscle content, respectively. This study showed that live body and carcass measurements have significant relationships with carcass components in Omani sheep. These relationships may be utilized for prediction of carcass composition in live animals as well as for carcass quality assessment.

Prediction of carcass composition from either live animal or the carcass has an important use in the meat industry. Live animal body measurements are used for evaluation of breeding stock because they enable performance testing and consequently selection of suitable breeding stock. Beside body measurements, techniques that are used for prediction of carcass composition in live animals include dilution techniques which are based on the assessment of total body water, such as tritiated water, and ultrasonic scanning. Live body measurements are practical, reasonably accurate, inexpensive and need much less technical ability compared to other methods used for the same purpose. Carcass measurements provide useful information for evaluation and grading of meat animal carcasses. Methods used for carcass assessment also include: specific gravity, sample joint and cuts analyses, physical dissection and chemical analysis. Compared to these methods, carcass measurements are easy to take, inexpensive, need less technical skill and cause least harm to the carcass. The relationships between live animal body and carcass measurements with body composition has been reported (Taneja, 1955; Orme *et al*, 1962; Tomov, 1975; Edriss, 1992). Measurements such as carcass length, GR, rib-eye muscle area and fat depth is routine for carcass grading and evaluation in many countries such as the UK, New Zealand, Australia, and U.S.A. However, this does not apply for the meat industry in most developing countries where meat is still sold by weight regardless of its quality or site on the carcass. Live body measurements are also not widely used in breeding programs for performance or progeny testing. This study was aimed at investigating the relationships between live body and carcass measurements and carcass major components to evaluate their potential use for prediction of carcass composition in Omani sheep.

Materials and Methods

Data used in the study were obtained from a trial carried out to investigate effects of castration and sex performance of Omani sheep. Materials and methods have been described previously (Mahgoub, Horton and Olvey, 1998). Briefly, thirty two Omani sheep (24 rams and 8 ewes) were randomly assigned after birth to one of four treatments of eight lambs each. Treatments included: males left intact, males castrated at two weeks of age using elastrator's rubber rings, males castrated at weaning using a burdizzu, and intact female lambs. Experimental animals were fed *ad libitum* creep feed (15% CP) from birth until weaning. From weaning until slaughter at an average weight of 26 kg, lambs had *ad libitum* access to concentrate sheep feed (CP 16%) plus chopped Rhodegrass hay (CP 8%). Water and salt blocks were available *ad libitum*. Lambs were weighed weekly from birth to slaughter.

Animals were slaughtered the Muslim halal way when each individual animal reached the designated body weight. Carcass and non-carcass components were weighed immediately after slaughter and carcasses chilled overnight at 4°C then wrapped in polyethylene bags and stored at −15°C for dissection. The weight of digestive content was computed as the difference between slaughter weight and weight of digestive content. The carcass was split along the vertebral column into left and right halves using a band saw. The left half was separated into seven wholesome commercial cuts (chuck, plate, rack, brisket and foreshank, leg, loin and flank) according to the method of Levie (1967). Each cut was further dissected into muscle, bone, fat and connective tissue. The amounts of muscle, bone and fat in each cut were added to give total half carcass muscle, bone and fat. These values were doubled to give total carcass muscle, fat and bone.

Live animal body measurements were taken prior to slaughter according to the methods of Searle *et al,* (1989) and Edriss, 1992) using a measuring tape and calipers. Measurements included: body length (from withers to hook bone); hook width (maximum width between outer edges of the pelvis); width at ribs (maximum width over the second last rib); shoulder width (maximum width between the lateral tuberosities of the humeri); depth of chest (the dorso-ventral distance between the most dorsal points over the withers and the ventral surface of the sternum); body height at withers; cannon bone length and width. Animals were restrained in as natural a position as possible. Each measurement was taken three times and the mean recorded.

Carcass measurements were obtained from the cold carcass. They included: carcass length (total vertebral column length); hook width; width at ribs (over second last rib); shoulder width; depth of chest; leg length; width and circumference; cannon bone length, width and weight. In addition to these measurements, the depth of tissue over the 11th rib 13 cm from the edge of the backbone midline (GR) was taken using a graded probe. Individual limb bones, ribs, pelvis, sternum and vertebrae were dissected out cleaned of adhering tissue and weighed. Fifteen muscles were selected from different parts of the carcass, dissected out, cleaned of adhering tissue and weighed. These included: MM. *biceps femoris, semimembranosus, semitendinosus, flexors* of the hindlimb, *longissimus thoracis et, lumborum, psoas major, obliquus internus abdominus, rectus abdominis, triceps brachii (caput longum), supraspinatus, extensor carpi radialis, flexors* of the forelimb, *pectoralis profundus* and *brachiocephalicus*.

Data were analyzed using correlation and regression options in SAS (1985) personal computers GLM procedure to study relationships between live animal body and carcass measurements and carcass major components (muscle, fat and bone). Stepwise regression analysis was used to find the maximum r^2 and best parameter estimates for multi variable models to estimate total carcass muscle at the 0.05 significance level.

Results and Discussion

There were no published reports on live body and carcass measurements and their use for prediction of carcass composition in sheep or other meat animals in Oman. Therefore, findings of the current study will be discussed in light of limited information on tropical as well as temperate breeds. The emphasis will be put mainly on relationships between experimental measurements and carcass muscle content because of its importance as the most edible and valuable carcass component. Relationships with bone and fat contents will be discussed wherever it is relevant.

Experimental animals were designated for slaughter at an average body weight of 26 kg. Slaughter, empty body and carcass weights ranged from 24.2 to 28.4, 22.2 to 26.1 and 14.1 to 16.9 kg, respectively. The small range of body weight over which animals were slaughtered in the current study may appear to have limiting effects on the extent of interpretation of its findings. However, this range represents approximately a one year body weight at which most Omani sheep are marketed. Slaughtered weights used in the current study have resulted in higher values of the regressions slopes (*b*) compared to those reported from similar studies using a wider body weight range with sheep and with goats (Edriss, 1992; McGregor, 1990). In the current study *ad libitum* fed sheep, a total of 32, of various sexes were used which may be questioned as using too few animals of different body composition for prediction of carcass contents. This is not unusual in studies of this kind. In work done by others, animals of different body composition, different breeds (Edriss, 1990) and as few number as 24 sheep (Mokhtar and Khaschab 1994) were used. Nonetheless, the current study should contribute to the cause of meat industry in Oman as it provides for the first time information on relationships between body carcass measurements and carcass components that may be used for evaluation of live animals and carcasses of native sheep.

LIVE BODY MEASUREMENTS: Correlation coefficients between live animal body measurements and body major components are presented in Table 1. There were positive correlations between slaughter weight, empty body weight (EBW) and hot carcass weight with total carcass muscle (r^2 = 0.57, 0.59, 0.59), fat (r^2 = 0.47, 0.48, 0.68) and bone (r^2 = 0.51, 0.44, 0.31) contents, respectively. There were also positive correlations between the body length (r^2 = 0.54), rib width (r^2 = 0.52) and leg length (r^2 = 0.44), and carcass muscle content and between leg length (r^2 = 0.71), height at withers, and cannon bone length, (r^2 = 0.46) and carcass bone content. None of the live animal body linear measurements had a significant relationship with carcass fat content. This indicates that fat growth in the animal body is achieved independently from bone growth. Findings of the current study are in line with those reported for tropical sheep by Edriss (1992). He used Iranian fat-tailed sheep and reported positive correlations between live body measurements (body length, heart girth, cannon bone length and circumference, hook width and shoulder width), with body and carcass weights, total carcass muscle and bone weight but not with carcass fat content. In goats, body

TABLE 1

Correlation coefficients between live measurements and carcass components in Omani sheep slaughtered at 26 kg body weight

Body Component	Correlation Coefficient (r^2)										
	Slaughter Weight	EBW	Hot Carcass	Body Length	Hip Width	Rib Width	Shoulder Width	Chest Depth	Leg Length	Body Height	Cannon bone Length	Cannon bone Width
Slaughter weight		0.97^{c}	0.87^{c}	0.41^{a}	0.37	0.38	0.34	-0.04	0.39^{a}	0.30	0.05	0.30
Empty body weight	0.97^{c}		0.88^{c}	0.43^{a}	0.41^{a}	0.45^{a}	0.32	-0.12	0.32	0.28	-0.01	0.27
Hot carcass	0.87^{c}	0.88^{c}		0.29	0.28	0.42^{a}	0.14	-0.09	0.26	0.00	-0.07	0.01
Total carcass muscle	0.57^{b}	0.59^{c}	0.59^{c}	0.54^{a}	0.12	0.52^{a}	0.15	-0.20	0.44^{a}	0.23	0.16	0.36
Total carcass fat	0.47^{b}	0.48^{c}	0.68^{c}	0.10	0.27	0.17	0.14	0.23	0.06	0.25	-0.13	-0.24
Total carcass bone	0.51^{b}	0.44^{a}	0.31	0.32	-0.02	0.18	0.17	0.18	0.71^{c}	0.46^{a}	0.46^{a}	0.36

[abc] $P < 0.05$; 0.01; 0.001, respectively.

weight and length had significant correlations with carcass weight (McGregor, 1990). Body weight is easy to measure. Including it in statistical models should provide a useful tool for prediction of carcass composition for breeding programmes under field conditions. Heavier animals produce heavier carcasses and higher meat yields. Therefore, this should encourage sheep producers in Oman to produce heavier animals using modern intensive management systems.

Live body linear measurement is believed by breeders to be a good indicator for meatiness in meat animals (Edriss, 1992). They are easily obtained and should provide useful information for the evaluation of breeding stock in progeny and performance testing studies. Measurements which had significant correlations with carcass muscle content in the current study were: body length, rib width and leg length. These measurements are among those recognized as indicators of ideal characteristics of meat animals. Body length is influenced by variation in the number of vertebrae in the spinal column. This factor should be taken in consideration in selection procedures when using linear measurements for stock evaluation. Wider rib width reflects wider barrels which has always been regarded as a good characteristic of meat animals by animal breeders. Leg length reflects the development of limb bones which has been regarded as a 'pacemaker' for growth of muscles related to these bones and consequently to the growth of total carcass muscle (Hooper, 1978; Young and Sykes, 1987; Mahgoub, 1988). This view is substantiated in the present study by high correlations between leg length as well as the weight of individual bones with total carcass muscle. Higher carcass bone relative to carcass muscle content is not a desirable trait in meat animals. Therefore, measurements such as leg length and height at withers may be used in breeding programs for culling stock with potential high bone content.

CARCASS MEASUREMENTS: There were positive correlations between the carcass length (r^2 = 0.52), rib width (r^2 = 0.65), shoulder width (r^2 = 0.51), leg length (r^2 = 0.52), leg circumference (r^2 = 0.40), cannon bone width (r^2 = 0.59) and cannon bone weight (r^2 = 0.57) with carcass muscle content (Table 2). Carcass length (r^2 = 0.56), leg length (r^2 = 0.64), cannon bone width (r^2 = 0.46) and weight (r^2 = 0.74) had positive correlations with carcass bone content. This indicated that measurements may be used for prediction of carcass composition in Omani sheep. Carcass measurements are easily obtainable and therefore, may be practically included in models for carcass grading or evaluation. Cannon bone, in which width and weight had high correlations with carcass muscle content, should have a more practical use for prediction of carcass muscle and bone contents as indicated by Edriss (1992). This is because these bones are routinely separated from the carcass at slaughter.

Among all carcass measurements, GR, had a high positive correlation (r^2 = 0.67) with carcass fat content. This may be attributed to the fact that GR is a measure

TABLE 2

Correlation coefficients between carcass measurements and carcass components in Omani sheep slaughtered at 26 kg body weight

Body Component	Correlation Coefficient (r^2)												
	Carcass Length	Hip Width	Rib Width	Shoulder Width	7th rib Width	Chest Depth	Leg Length	Leg Width	Leg Circum	Cannon bone Length	Cannon bone Width	Cannon bone Weight	GR
Slaughter weight	0.34	0.26	0.36^a	0.34	-0.34	0.01	0.13	0.43	0.50^a	0.29	0.30	0.35	0.60^b
Empty body weight	0.35	0.22	0.45^a	0.37	0.06	-0.04	0.01	0.31	0.52^a	0.20	0.32	0.30	0.69^c
Hot carcass	0.34	0.32	0.52^a	0.39	0.08	0.08	0.12	0.31	0.60^a	0.22	0.04	0.09	0.67^c
Total carcass muscle	0.52^a	-0.03	0.65^c	0.51^a	0.25	0.35	0.52^b	0.31	0.40^c	0.26	0.59^b	0.57^a	0.28
Total carcass fat	-0.02	0.15	0.21	0.09	-0.08	-0.18	-0.05	0.11	0.37	0.07	-0.51^a	-0.26	0.67^c
Total carcass bone	0.56^b	-0.04	-0.08	0.05	0.08	0.34	0.64^b	0.22	0.22	0.40	0.46^a	0.74^c	0.09

^{abc}, P < 0.05; 0.01; 0.001, respectively.

of the thickness of tissue over the plate region which has a sizable cover of subcutaneous fat. The measurement has been commonly used in carcass grading procedures in meat producing countries such as the UK, New Zealand, Australia (Kirton and Morris, 1989) and is easy to obtain in abattoirs using a simple graded probe without causing much damage to the carcass. We recommend that it should be adopted in any carcass grading system Oman.

INDIVIDUAL BONES AND MUSCLES: Weight of most individual bones measured as well as weight of bone groups had positive correlations with carcass muscle (r^2 = 0.39-0.72) and bone (r^2 = 0.65-0.94) contents (Table 3). Watson and Broadbent (1968) and Edriss (1992) reported that linear measurements and weight of some long bones such as the tibia, correlated with carcass components. No individual bone weight had a significant relationship with carcass fat content. This

TABLE 3

Correlation coefficients between weight of individual bones and carcass components in Omani sheep slaughtered at 26 kg body weight

Body Component	Correlation Coefficient (r^2)									
	Scapula	Humerus	Radius & Ulna	Carpus	Femur	Tibia	Forelimb	Hindlimb	Axial Skeleton	Total Vertebral Column
Slaughter weight	0.46^a	0.34	0.28	0.04	0.39^a	0.46^a	0.21	0.41^a	0.44^a	0.41^a
Empty body weight	0.39^a	0.27	0.26	0.04	0.33	0.42^a	0.19	0.37	0.36^a	0.32
Hot carcass	0.42^a	0.23	0.19	-0.03	0.31	0.35	0.10	0.27	0.29	0.26
Total carcass muscle	0.55^b	0.25	0.72^b	0.51^b	0.21	0.75^c	0.66^c	0.68^c	0.17	0.39^a
Total carcass fat	-0.46^a	0.06	-0.41	-0.49^b	0.18	-0.25	-0.47	-0.31	0.24	0.06
Total carcass bone	0.65^b	0.82^b	0.85^c	0.72^b	0.82^b	0.87^c	0.84^c	0.86^c	0.94^c	0.87^c

abc, P<0.05; 0.01; 0.001, respectively.

TABLE 4

Correlation coefficients between weight of individual muscles and carcass components in Omani sheep slaughtered at 26 kg body weight

Body Component	Correlation Coefficient (r^2)														
	Biceps femoris	Semimembinosus	Semitendinosus	Gastrocnemius	Hindlimb flexors	LD@	Psoas major	Obliques internus abdominis	Rectus abdominis	Triceps brachii (c. longum)	Supraspinatus	Extensor carpi radialis	Forelimb flexors	Pectoralis Profundus	Brachiocephalicus
Slaughter weight	0.50^a	0.48^a	0.49^a	0.39^a	0.26	0.33	0.40^a	0.53^a	0.60^b	0.45^a	0.47^a	0.27	0.37^a	0.50^a	0.40^a
EBW	0.53^a	0.52^a	0.51^a	0.38^a	0.23	0.41^a	0.41^a	0.51^b	0.61^c	0.49^a	0.44^a	0.19	0.35	0.56^a	0.43^a
Hot Carcass	0.53^a	0.55^b	0.49^a	0.49^a	0.21	0.47^a	0.34	0.56^a	0.56b	0.48^a	0.52^b	0.11	0.40^a	0.50^a	0.30
Carcass muscle	0.79^c	0.73^c	0.65^c	0.70^c	0.42^a	0.64^c	0.35	0.47^a	0.32	0.85^c	0.67^c	0.41^a	0.71^c	0.56^a	0.51^a
Carcass fat	-0.08	0.01	0.01	0.03	-0.04	0.11	0.00	0.14	0.28	-0.03	0.07	0.33	-0.15	-0.01	-0.17
Carcass bone	0.56^a	0.43^a	0.49^a	0.49^a	0.22	0.32	0.44^a	0.31	0.34	0.43^a	0.50^a	0.55^a	0.44a	0.38	0.58^a

abc P<0.05; 0.01; 0.001, respectively. @ muscle substantiates the findings from live body linear measurements that indicate growth of bone and fat in the animal body occurs independently.

Except for MM *psoas major* and *rectus abdominis*, there were positive correlations (r^2 = 0.41-0.85) between the weight of all individual muscles and total carcass muscle content (Table 4). There were also positive correlations (r^2 = 0.43-0.58) between the weight of MM *biceps femoris, semimembranosus, semitendinosus, gastrocnemius, psoas major, triceps brachii (caput longum), supraspinatus, extensor carpi radialis, flexors* of the forelimb and *brachiocephalicus* and carcass bone content. No individual muscle had any significant relationship with carcass fat content. These findings indicate that growth of the musculature of the whole body is correlated whereas musculature and fat grow independently. *MM. psoas major* and *rectus abdominis* are late maturing (Butterfield, 1988) which may explain the lack of correlation of these muscles with the growth of total musculature of the body. Other individual muscles may be used as indicators for carcass composition without causing much damage to the carcass especially in situations where meat is sold in cuts or as boned or for experimental purposes.

There were positive correlations between the weight of the chuck (r^2 = 0.62), brisket and shank (r^2 = 0.38), leg (r^2 = 0.79) and short loin (r^2 = 0.45) with muscle content of the carcass (Table 5). Muscle content of carcass cuts, with the exception of the plate, had positive correlations (r^2 = 0.46-0.86) with total carcass muscle content. There were also positive correlations between bone content of the chuck (r^2 = 0.57), brisket and shank (r^2 = 0.58) and leg (r^2 = 0.65) with muscle content of the carcass. Fat and bone content of each cut had a high positive correlation with total carcass fat (r^2 = 0.62-0.83) and total carcass bone (r^2 = 0.45-0.90) content, respectively. The weight of the chuck and leg cuts had a high positive correlation with total carcass bone content (r^2 = 0.57 and 0.72, respectively). These findings are in line with those reported for Saudi sheep (Mokhtar and Khaschab, 1994). In a study carried out on five sheep breeds they found that the weight of the rack was the most important predictor for estimation of lean weight of the side, followed by leg weight. The proportions of lean in each cut was the strongest predictor of lean proportions in the carcass. Prediction of lean content as weight or proportion from dissected cuts of leg, loin and rack provided the most precise estimates. These findings as well as those of current study indicate the possibility of the use of the carcass cuts to estimate carcass composition in tropical sheep as now occurs in temperate sheep. This will reduce cost, labor and time.

TABLE 5

Correlation coefficients between weight of carcass cuts and components and carcass tissues in Omani sheep slaughtered at 26 kg body weight

	Correlation Coefficient (r^2)		
Carcass Cut and Its Components	**Carcass Muscle**	**Carcass Fat**	**Carcass Bone**
Chuck weight	0.62^c	0.29	0.57^c
Fat	-0.03	0.81^c	0.10
Muscle	0.81^c	-0.13	0.65^c
Bone	0.57^b	-0.16	0.90^c
Plate Weight	-0.10	0.62^c	-0.14
Fat	-0.23	0.81^c	-0.36
Muscle	0.18	0.01	0.20
Bone	0.35	-0.12	0.56^b
Rack Weight	0.31	0.46^a	0.05
Fat	-0.09	0.80^c	-0.16
Muscle	0.51^a	-0.03	0.04
Bone	0.04	-0.14	0.45^a
Brisket & Shank Weight	0.38^a	0.16	0.23
Fat	0.01	0.63^c	0.03
Muscle	0.46^a	-0.17	0.17
Bone	0.58^c	-0.23	0.71^c
Leg Weight	0.79^c	0.26	0.72^c
Fat	0.06	0.79^c	0.20
Muscle	0.86^c	0.02	0.66^c
Bone	0.65^c	-0.14	0.90^c
Loin Weight	0.45^a	0.45^a	0.10
Fat	-0.07	0.62^c	-0.17
Muscle	0.57	0.02	0.05
Bone	0.18	0.26	0.62^c
Flank Weight	0.21	0.70^c	-0.04
Fat	-0.10	0.83^c	-0.24
Muscle	0.66^c	0.11	0.31
Bone	-0.27	-0.21	-0.12

[abc] $P<0.05$; 0.01; 0.001, respectively.

REGRESSION ANALYSIS: The regression equations describing the relationships between live animal and carcass measurements with carcass components are presented in Tables 6 and 7. The regression coefficient *b* describes the slope or the rate of change in a body or a carcass component such as muscle, bone or fat (dependent variable) with an increase in the body or carcass measurement (independent variable). For example, there should be an increase of 927 and 569 g in EBW and hot carcass weight. An increase of one

TABLE 6

Regression equations describing relationships between live and carcass measurements with carcass components of Omani sheep slaughtered at 26 kg body weight

Dependent Variable	Intercept *(a)*	Regression Coefficient *(b±sd)*	Independent Variable	r^2
Live animal measurements				
EBW	-27.56	0.927^c (0.044)	Slaughter Weight	0.94^c
Hot carcass weight	158.60	0.569^c (0.062)		0.75^c
Carcass fat	-655.43	0.159^b (0.056)		0.23^b
Carcass Muscle	1091.83	0.217^c (0.059)		0.33^b
Carcass Bone	281.89	0.052^b (0.017)		0.26^b
Carcass Fat	-1716.45	0.347^c (0.070)	Hot carcass weight	0.47^c
Carcass Muscle	1650.31	0.339^c (0.088)		0.35^c
Carcass Bone	903.77	0.049 (0.028)		0.10
Stepwise Analysis[a]				
Live body measurements				
Total carcass muscle	-173.57	10.08^b (2.26)	Body length	0.84^c
		-23.51^b (6.18)	Chest depth	
		21.57^b (6.62)	Leg length	
Carcass measurements				
Total carcass muscle	259.59	0.27^c (0.04)	Hot carcass weight	0.70^c
		-6.41^a (2.35)	Hook width	
		3.89^a (1.81)	Rib width	
		-73.05^c (14.38)	GR	

abc, $P<0.05$; 0.01; 0.001, respectively. EBW = empty body weight

TABLE 7

Regression equations describing relationships between weight of individual bones and muscles and weight and composition of carcass cuts and carcass muscle content in Omani sheep slaughtered at 26 kg body weight

Dependent Variable Total carcass muscle	Intercept *(a)*	Regression coefficient *(b±sb)*	Independent Variable	r^2
Individual bones				
	2906.20	10.463^b (2.99)	Scapula	0.30^b
	1843.35	30.014^c (5.52)	Radius & Ulna	0.51^c
	1256.40	29.379^c (4.91)	Tibia	0.56^c
Individual muscle				
	2267.87	24.887^c (2.70)	*m. Biceps femoris*	0.75^c
	2977.69	42.459^c (9.08)	*m. Gastocnemius*	0.44^c
	3406.34	10.610^c (2.13)	*m. Longissimus thoracis et Lumborum*	0.48^c
	3029.40	47.433^c (9.70)	*m. Supraspinatus*	0.47^c
	3990.64	61.780^c (12.40)	*m. Brachiocephalicus*	0.47^c
Carcass cuts				
	1495.55	1.025^c (0.25)	Chuck weight	0.40^c
	1297.91	2.027^c (0.28)	Chuck muscle	0.65^c
	711.55	2.170^c (0.24)	Leg muscle	0.75^c
	2463.57	2.822^c (0.77)	Loin muscle	0.32^b
	1968.49	8.731^c (1.86)	Flank muscle	0.44^c

abc $P<0.05$; 0.01; 0.001, respectively.

kilogram in slaughter weight should produce an increase of 159, 217 and 52 g of carcass fat, muscle and bone, respectively (Table 6). Likewise an increase of one kg hot carcass weight should result in an increase of 347, 339 and 49 g of carcass fat, muscle and bone, respectively.

The r^2 of the regression analysis indicated that slaughter weight is a significant predictor for EBW, carcass weight and its fat, muscle and bone components. The strongest relationships were with EBW (0.94) and carcass weight (0.75). Carcass weight was a strong predictor for carcass fat and muscle but not for bone content. Stepwise regression analyses of live body and carcass measurements with total carcass muscle content at the 0.05 significance level are presented in Table 6. Body length, chest depth and leg length accounted for 84% of the variation in the total carcass muscle content. The three live body measurements represented the best parameter estimates in a model for prediction of total carcass muscle content. Hot carcass weight, hook width, rib width and GR measurements accounted for 70% of the variation in the total carcass muscle content (Table 6). These four measurements represent the best parameter estimates in a model for prediction of total carcass muscle content. The live body and carcass measurements may be used in a commercial model for the evaluation of live animal and carcasses in Omani sheep.

In closing, this study has shown the relationships between live body and carcass measurements with carcass components which may be used for prediction of carcass composition and carcass evaluation in the meat industry in Oman.

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