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Using Body Measurements and Real-Time Ultrasound to Evaluate Carcass Characteristics of Male Damascus Kids

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Abstract

LINEAR BODY MEASUREMENTS and real-time ultrasound may serve as crucial factors in cost-effective carcass prediction, thereby facilitating value-based marketing of living animals. The current study aimed to evaluate carcass components and cuts of male Damascus kids from body and ultrasound measurements. Besides investigate the effect of presence of horns and type of birth (single or twins) on body measurements and carcass characteristics. Thirteen male Damascus kids aged 12 months were used in the study. Ultrasound measurements were taken with probe (7.5 MHZ) between the 12th and 13th thoracic vertebra on live kids.

Body measurements, carcass components and cuts of horned kids were higher than those of hornless ones. The birth type showed no significant influence on body weight and measurements at 12 months and on carcass components and cuts. Body length was entered in all prediction equations to predict carcass cuts and measurements. Afterward, heart girth and chest width were the most variables used in prediction equations. Ultrasound measurements (depth, area and width) of rib-eye muscle on live kids led to accurate prediction for weights of hot carcass, leg, flank, shoulder, neck, best end of neck and middle neck in their carcasses. Accurate prediction equations were obtained to predict real eye muscle width, depth and area using ultrasound measurements of rib-eye muscle width, depth and area, respectively. R^2 accounted 33% to predict width of rib-eye muscle ($P<0.05$). Moreover, ultrasound depth and area of rib-eye muscle contributed 51% and 61%, respectively of the total variation in real depth and area of eye muscle ($P<0.01$).

Keywords: Damascus kids, Body measurements, Ultrasound measurements, Prediction equations, Carcass components and cuts.

Introduction

Goats are highly spread around the world and are highly adaptable to a variety of environmental conditions and the availability of feed. Around 41% and 53% of the world's goats are bred in Africa and Asia, respectively [1]. Some goat breeds specialize in milk production, while other goats are raised for meat production. In dairy goats, the surplus male kids of the flock are directed to meat production. Goat meat has become more prevalent among consumers because it has highly nutritional qualities from other red meats. It has a low total fat percentage, low in saturated fatty acids and cholesterol, low caloric, a good source of vitamin B_{12}, and high iron [2]. Thus, goat meat has high nutritional value and it is benefit to human population health [3].

Evaluating the characteristics and components of carcasses in live animals has become necessary. Non-invasive and non-destructive techniques required to evaluate the characteristics of carcass in living animals. Modern techniques such as x-ray, computer tomography, linear body measurements and ultrasound scanning [4-5] can be used to predict the carcass composition of live animals. Numerous investigators have documented a strong correlation between ultrasound measurements and physical measurements taken directly on the carcass [6, 7, 8, 9, 10, 11]. In this context, Edwards et al. [12], Stanford [13], Will and Gonzalez [14], Romdhani and Djemali [15], Silva et al. [16], Leeds et al. [17], Thériault et al. [18], Agamy et al. [19], Akdağ et al. [20] and Gomes et al. [10] showed that using ultrasound measurements between 12^{th} and 13^{th} thoracic vertebrae was more accurate to predict carcass components of sheep. Predicting the carcass composition of sheep and goats is useful for evaluating the performance, grading, and breeding selection scheme [9]. Ilisiu et al. [21] pointed out that

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real-time ultrasonography is a suitable method for evaluation and quantification in the field of early life of animals, which helps us to select superior animals in breeding programs. Nevertheless, few goat studies have focused on establishing equations to predict carcass components and cuts in live animals. Furthermore, there is a lack of information regarding the prediction of carcass components in Damascus kids raised under Egyptian conditions.

The current study aimed to investigate the relationship between linear body measurements, ultrasound technique, and carcass characteristics in male Damascus kids. Another aim was to establish prediction equations to predict carcass traits and rib-eye muscle dimensions using body measurements and ultrasound technique of kids. The influence of the presence of horns and type of birth on body weight, body measurements, carcass components and cuts were also examined.

Material and Methods

This research was carried out at the Agricultural Experiments Station, Faculty of Agriculture, Cairo University, situated in Giza, Egypt. The geographical coordinates of the station are approximately 30°02′ N latitude and 31°13′ E longitude, at an altitude of 30 meters. The study protocol was approved by Cairo University's Institutional Animal Care and Use Committee (CU-IACUC) under approval number CU II F 32 22. This experiment was conducted during the period from May 2022 to March 2023.

Animals and management

Thirteen males of Damascus kids were used in this experiment. Kids aged 4 months, with an average body weight of 16.7±0.9 Kg. Ten kids had horns, whereas three ones were hornless. Five kids were single-born, whereas 8 ones were twin-born. They were raised in free as a group in semi-shaded open yards. According to NRC requirements [22], the kids were grouped and fed based on their live body weight. They were supplemented daily with 250 grams of concentrates per head at the beginning of experiment and 500 grams per head at the end of study. The concentrate mixture comprised of 50% yellow corn, 25 %wheat bran, 15% soybean cake, 5% sunflower seed cake 1.5% limestone, 1% common slate, 0.5%minerals, 0.2% vitamins mixture, 0.3% yeast extracted and 1.5% sodium bicarbonate. The crude protein and TDN were estimated as 16% and 70%, respectively. Kids were offered on Egyptian clover (*Trifolium alexandrinum*) and Darawa (*Zea maize L.*) according to its availability. Mineral blocks and water were easily available during the day.

Body weight and measurements

Living body weight (BW, to the nearest 0.1 kg) and all body measurements were estimated monthly up to 12 months of age. The body measures have been measured with a measuring instrument to the nearest 1mm on the left side of Damascus kids. The body measurements (Figure 1) were: (a) Body height at chest (BHC): The vertical distance from the highest point of the shoulders (withers) to the floor, (b) Heart girth (HG): The circumference of the body directly behind the foreleg, (c) Paunch girth (PG): The circumference of the body directly before the hind legs, (d) Body length (BL): The horizontal distance from the point of the shoulder to the pin bone, (e) Neck length (NL): The distance from the end point of the shoulder to the base of the head, (f) Neck circumference (NC): The circumference of neck from the middle position, (g) Chest width (CW): The width of the body at the withers, (h) Chest depth (CD): The vertical distance from the highest point of the shoulders (withers) to the bottom of the chest, (i) Round circumference (RC): The circumference of the thigh just under the body level, (j) Pelvis width (PW): The distance between the two hocks, and (k) Body height at pelvic (BHP): The vertical distance from the highest point of the pelvic (rump) to the floor.

Real-time ultrasound measurements

The ultrasound measurements were recorded monthly and before slaughtering measured by IMAGO echo control medical 1810MG05 with linear rectal Probe 7.5 MHz (IMV imaging). Real-time ultrasound scan was captured at the same anatomical site over the study period, at the thoracic area between the 12th and 13th ribs on the left side of the kid, transverse to the vertebral column [11]. After shearing the hair from the measurement area, we meticulously palpated the scanning areas using careful sensory examination. Subsequently, we applied ultrasonic gel as a conductive medium to ensure optimal and enhanced contact between the transducer head and the goat's skin.

Real-time, satisfactory images were captured and frozen on the monitor. We utilized device tools to accurately track the area of the *Longissimus dorsi* muscle (Figure 2), facilitating measurements of subcutaneous back fat thickness (UFT), muscle depth (ULMD), muscle width (ULMW) and muscle area (ULMA).

Carcass measurements and cuts

Immediately prior to slaughter, we recorded the body weight and linear body measurements of all kids. Following an 18-hour fasting period, the animals were slaughtered at the slaughterhouse located at the Agricultural Experiments Station of the Faculty of Agriculture, Cairo University. The body weight recorded at slaughter served as the basis for calculating the dressing percentage. The kids were slaughtered in accordance with Muslim (halal) tradition, At the atlanto-occipital joint, the neck's major blood vessels and throat were cut. Following bleeding, the body weight was measured to determine blood weight, after which the carcass was skinned. All carcass compositions and internal organs were weighed (head, skin, feet, carcass with internal organs, heart, lunge with trachea, liver, kidney, spleen, testis, full digestive tract, empty digestive tract). Mesenteric fat, kidney fat and heart fat were dissected and their weights were measured. Afterwards, the hot carcass weight (about 1h after slaughtering) was estimated. Subsequently, the carcass was divided longitudinally into approximately two equal parts and weighed. Carcass measurements were conducted on the left half of hot carcass as recommended by Houria [23] and Abdel-Moneim [24]. These measurements consisted of the width of the carcass at the 3rd rib, the width of the carcass at the 7th rib, the length of the thigh, the circumference of the thigh, and the length of the carcass. The left and right halves of the carcass were cooled for 24 hours at 4°C. Each chilled carcass half was weighed. Then, the chilled left half of each carcass was segmented into eight cuts according to Abdel-Moneim [24]. These sections of the carcass included the leg, loin, flank, shoulder, brisket, neck, and middle neck (from the 1st to the 5th dorsal vertebra) and best end of neck (from the 6th to the 13th dorsal vertebra). The last three ribs (11th, 12th and 13th ribs) were separated. Each rib was put on semi-transparent tracing paper (Calc paper) to draw the longissimus dorsi muscle and to determine muscle area by digital planimeter (PLANIX 5). The depth and the width of muscle for each rib were determined by ruler. Carcass subcutaneous backfat thickness was measured by calliper. Each estimation was repeated three times and averaged.

Statistical analysis of data

Data were statistically tested using the least squares procedure of the General Linear Model (GLM) with SAS statistical package [25]. The influences of presence of horns and type of birth on body weight and measurements, carcass components and cuts and rib-eye muscle measurements were examined. All effects were regarded as fixed, except for the random error, which was assumed to follow a normal distribution and be independent, with a mean of 0 and a variance of $\sigma 2$. The Duncan's Multiple Range Test was used to test the differences among means of studied traits. Correlation coefficients were statistically computed between body weight, body measurements, carcass traits, and cuts, as well as between ultrasound measurements of the rib-eye muscle and actual measurements of the rib-eye muscle and carcass cuts. To predict carcass traits and rib-eye muscle measurements from body measurements and ultrasound measurements of Damascus kids, a stepwise approach was used to choose variables for the prediction equations. Variables not significantly (with a P-value higher than 0.05) were not considered in the procedure. The coefficient of determination (R^2) was used to evaluate the precision of the equations.

Results

Effect of presence of horns and type of birth

It is apparent from Table 1 that horned Damascus kids aged 12 months had significantly ($P < 0.05$) higher pre-slaughter body weight, body height at chest and at pelvic, chest depth, heart girth, body length, neck circumference and round circumference than hornless kids. Also, paunch girth and neck length were higher in horned kids than in hornless ones, but the differences were insignificant. Meanwhile, least square analysis of variance indicated that presence of horns had high significant impact on body weight, heart girth and body length ($P < 0.01$), whereas it exerted a significant impact on body height at chest and at pelvic, chest depth and round circumference ($P < 0.05$) (Table 1).

On the other hand, Duncan's Multiple Range Test indicated that kids born singly were heavier than those born as twins with significant level ($P < 0.05$) (Table 1). Furthermore, body height at chest, body length, neck circumference and round circumference were significantly ($P < 0.05$) higher for single-born kids than those of twins. However, the impact of the type of birth on body weight and measurements did not reach a significant level. (Table 1).

It is of interest that all carcass components and cuts of horned kids were higher than hornless kids with significant level ($P < 0.05$), except spleen weight, full digestive tract weight, mesenteric fat weight, kidney fat weight, heart fat weight and loin weight where they did not differ significantly between horned and hornless kids (Table 2). Moreover, least squares analysis of variance (Table 2) showed that presence of horns had no significant influence on weights of skin, spleen, mesenteric fat, kidney fat, heart fat, loin and flank of Damascus kids.

Though type of birth exerted a non-significant effect on all carcass components and cuts of Damascus kids (Table 2), Duncan's Multiple Range Test indicated that most carcass components and cuts of single-born kids were higher than twin-born kids with significant level ($P < 0.05$) (Table 2). Nevertheless, Duncan's Multiple Range Test did not show significant statistical differences among means of weights of feet, lungs, testis, full digestive tract, mesenteric fat, kidney fat, heart fat, loin, flank and brisket due to type of birth (Table 2).

The relationships among different traits

It is noteworthy to mention that the dressing percentage of male Damascus kids exhibited a positive and significant correlation ($P < 0.01$) with body length and body height at the pelvic level (Table 3). Furthermore, the correlation coefficients between dressing percentage and each of pre-slaughter weight, body height at chest, heart girth, chest depth and round circumference were positive and significant ($P < 0.05$). Positive but insignificant correlation coefficients were found between dressing percentage and chest width, paunch girth and pelvis width (Table 3). Conversely, pre-slaughter weight displayed positive and significant correlation coefficients with all carcass components and cuts except full digestive tract, kidney fat and heart fat weight, where they were positively but insignificantly correlated with body weight (Table 3). Furthermore, body measurements were positively associated with carcass components and cuts. Nevertheless, negative but insignificant correlation coefficients were obtained between mesenteric fat, kidney fat and heart fat with body height at pelvis and round circumference. In the meantime, heart fat was negatively but insignificantly correlated with body length, heart girth and pelvic width (Table 3).

The results (Table 4) clearly indicate that there are positive relationships between the monthly measurements of the area, depth and width of rib-eye muscle estimated by ultrasound on live Damascus kids and those measurements of 11th, 12th, and 13th, ribs of their carcasses. Moreover, body weight and ultrasound measurements of eye muscle estimated between the 12th and 13th ribs immediately before slaughtering were positively and significantly correlated with the area, depth and width of the eye muscle at 11th, 12th and 13th ribs in the carcass (Table 5). In this respect, the correlation coefficient between the eye muscle width estimated by ultrasound before slaughter and the width of eye muscle at 11th rib in carcass was positive but insignificant (Table 5). In this context, it is of interest (Table 6) the ultrasound measurements of the area and depth of the eye muscle between the 12th and 13th ribs in live kids were positively and significantly ($P < 0.01$) correlated with the weights of the hot carcass, right and left halves of hot carcass, left and right halves of cold carcass, leg, flank, shoulder, neck, best end of neck and middle neck. The same trend was found for the correlation coefficients between the width of the eye muscle and the carcass traits which were mentioned before, where they were positive and significant. Except for the correlation coefficient between the width of eye muscle and middle neck, where it was positive but insignificant (Table 6).

As shown in Table 7 that there are positive and significant correlation coefficients between the lean weight separated from the 13th rib and the ultrasound measurements of depth ($P < 0.01$), area ($P < 0.05$) and width ($p < 0.05$). However, there were weak correlations between the weights of fat and bone in the 13th rib and ultrasound measurements of rib-eye muscle. It is striking that the correlation coefficient between bone weight in the 13th rib and eye muscle area of that rib was negative but not significant (Table 7).

Predicting carcass characteristics

Results in Table 8 show that eight variables (BL, BHC, BHP, HG, CD, CW, RC and PW) were used in prediction model to predict pre-slaughter weight (R^2 = 97%), hot carcass weight (R^2 = 97%) and leg weight (R^2 = 96%) of male Damascus kids. For dressing percentage, PSW, BL, BHC, HG, CD and RC were the independent variables of the prediction model with an accuracy of 81%. Furthermore, six body measurements could be included for prediction neck weight (R^2 = 89%) and best end of neck (R^2 = 90%). Moreover, BL, HG, CD, CW and RC were found to be predictors for shoulder weight (R^2 = 90%). It is of interest that loin weight could be predicted through four variables (BL, BHP, CW and PW) with coefficient of determination (R^2) being 73%. Three body measurements were used in the model for predicting flank weight (BL, CW and PW, R^2 = 73%) and brisket weight (BL, HG and CW, R^2 = 68%). The equation including BL and CW could predict middle neck weight with an accuracy of 53% (Table 8).

In this context, it is apparent in Table 9 that BL, HG, CD and CW were added to predict carcass width at 3rd rib in male Damascus kids with an accuracy of 75%. The final prediction model included BL, BHC, HG, CD and CW were used to predict carcass width at 7th rib with an accuracy of 86%. Meanwhile, three body measurements (BL, CW and PW) were included in the model for predicting round length (R^2 =58%). Whereas, the variables BL, BHC and PW were predictors of round circumference in the model with coefficient of determination (R^2) being 71%. Moreover, for predicting carcass length, BL, CW and PW were the independent variables of prediction model (R^2 = 71%).

Regarding the use of ultrasound measurements of rib-eye muscle to predict carcass cuts, Table 10 shows that the parameters MWUS, MDUS and MAUS were predictors for weights of hot carcass, leg, flank, shoulder, neck, best end of neck and middle neck in male Damascus kids. The coefficients of determination (R^2) were 67% for hot carcass weight, 80% for leg weight, 62% for flank weight, 82% for shoulder weight, 71% for neck weight, 68% for best end of neck and 76% for middle neck (Table 10).

Table 11 reveals that it could be used ultrasound measurements of the eye muscle area, depth, and width between the 12th and 13th thoracic vertebrae on live Damascus kids to predict area, depth and width of eye muscle in their carcasses. The coefficient of determination (R^2) accounted 33% to predict width of eye muscle ($P < 0.05$). Moreover, ultrasound depth and area of eye muscle contributed 51% and 61%, respectively of the total variation in real depth and area of eye muscle ($P < 0.01$).

Discussion

Several studies have been published on body measurements and real-time ultrasound for predicting carcass composition and meat quality at different ruminant species and breeds [9 ,10]. Nevertheless, in our utmost information, no studies have been conducted on Damascus goats in this field under Egyptian conditions. Moreover, recent advances in instrumentation, such as portable and handheld devices, combined with increased computing power have facilitated the prediction of carcass composition with greater accuracy.

Our results showed that body weight, body measurements, carcass components and cuts of horned kids were higher than those of hornless ones. These results are in accordance with those found by Kridli *et al*. [26] and Sam *et al*. [27]. Kridli *et al*. [26] reported that horned bucks tended to be heavier than polled bucks. Sam *et al.* [27] found that West African Dwarf goats with horns were significantly superior in body length, heart girth and height at wither compared with hornless goats. Meanwhile, Côté *et al*. [28] showed that total length of horns was positively correlated with mass, chest girth and hind foot length in both male and female mountain goats. In this context, Leng Jing *et al*. [29] indicated that the absence of tip horn torsion in Longling Yellow goats had positive and significant influence on body weight and measurements.

It is interesting to mention that there was no significant effect due to birth type influence on body weight and measurements at 12 months and on carcass components and cuts (Tables 1and 2). This result may be attributed to a declining maternal influence and a growth compensation observed in twin kids, as reported by Liu *et al.* [30]. The authors demonstrated that the disparities between singles and twins diminished as the kids matured. Deribe and Taye [31] reported that at yearling age, the type of birth had no significant impact on body weight and carcass characteristics of kids. Nevertheless, the means of pervious traits in this study were higher in single kids compared to twins (Tables 1 and 2). The attained results coincided with those reported by Liu *et al.* [30], Mellado *et al*. [32], Deribe and Taye [31], Bushara *et al*. [33], Kurniawati *et al.* [34] and Güler *et al.* [35]. Liu *et al.* [30] discovered that twin kids had lower birth weights and slower early growth rates compared to singletons, but they showed a higher growth rate after weaning. Meanwhile, Mellado *et al*. [32] mentioned that regardless of breed, the average birth weight of kids born as twins, triplets, and quadruplets was 92%, 87%, and 83% of that of singleton kids, respectively. Furthermore, Kurniawati *et al.* [34] found that body weight, body length, heart girth and withers height in single born of Bligon kids at birth and weaning were significantly higher than those in twins. In this respect, Güler *et al.* [35] pointed out that twin kids had a higher maturity index than singles.

It is well established that there are strong and positive relationships between body weight and measurements of live Damascus kids and their carcass characteristics (Table 3). The attained results are in accordance with the findings in goats by Jibir *et al.* [36] and Mcgregor [8] and in sheep by Berg *et al*. [37], Shehata [38], Agamy *et al*. [5] and costa *et al.* [39]. Jibir *et al.* [36] reported that linear body measurements of Red Sokoto and Sahel goats (body length, height at withers, chest girth, chest depth and chest width) were correlated with their carcass linear measurements (length, width, and depth of carcass and leg length). Mcgregor [8] found that body volume (circumference × girth) of Angora goats performed better for estimating live weight than heart girth or body circumference. In this context, Costa *et al.* [39] showed that the best and accurate body measurements applied to predict slaughter body weight, empty body weight, hot carcass weight and cold carcass weight in Morada Nova ram lambs were body length, wither height, breast width, thigh perimeter, rump perimeter, rump width and thigh length. It is worthy to note (Table 3) that the correlation coefficients of mesenteric fat, kidney fat and heart fat with body height at pelvic and round circumference were negative but insignificant. Furthermore, heart fat weight was negatively correlated with body length, heart girth and pelvis width (Table3). It is possible to expect that the higher body length, body height at pelvic, heart girth, round circumference and pelvis width of the kids, the lower internal fat content in their carcasses.

On the other hand, it was found that there are strong and positive correlations between monthly ultrasound measurements of eye muscle (depth, area and width) between the 12^{th} and 13^{th} ribs in live kids and the actual measurements of eye muscle at the 11^{th}, 12^{th} and 13^{th} ribs after slaughtering (Table 4). Moreover, pre-slaughter body weight and ultrasound measurements of eye muscle were significantly and positively correlated with real measurements of eye muscle at the 11^{th}, 12^{th} and 13^{th} ribs (Table 5). Will and Gonzalez [14] found that eye muscle area and depth between 12^{th} and 13^{th} ribs by ultrasound in Spanish goats were significantly ($P<0.01$) and positively correlated with the area and depth of eye muscle in carcass ($r = 0.75$ and 0.71, respectively). Monau and Nsoso [6] found that there was no significant difference between ultrasound measurements and carcass measurements by ruler in kids. The authors showed that all ultrasound measurements had highly significant correlations with rule measurements ($r^2 = 0.962$ to 1.0). Lazăr *et al.* [11] showed that body weight of kids was significantly and positively correlated with ultrasound measurements of muscle area and depth ($r= 0.83$ and 0.73, respectively). The same trend was also found in sheep. Edwards *et al.* [12] reported that there was significant correlation between ultrasound estimation at 12th and 13th ribs in live lambs and fat thickness and muscle in their carcasses. Similar reports were made by Orman *et al.* [40] who found that the correlation coefficients of eye muscle area and depth measured by ultrasound at 12th and 13th ribs were positively and statistically significant correlated with area and depth of eye muscle in lamb carcass. Contrariwise, there was no correlation between the width of the muscle measured by ultrasound and the width of the muscle in the carcass. Vardanjani *et al*. [7] confirmed that there was a highly statistical correlation between ultrasound measurements in live lambs and real measurements on carcass.

As shown in Table 6, the width, area and depth of eye muscle estimated by ultrasound between the 12th and 13th ribs on live kids were positively correlated with the weights of carcass cuts. Leeds *et al.* [17] found that ultrasound measurement of longissimus area (measured at 12th and 13th ribs) was positively and significantly correlated with weights of shoulder, fore shank, breast, rack, loin and leg in Suffolk and Texel carcass. The authors showed that the area of eye muscle by ultrasound was stronger correlation with carcass cuts than ultrasound depth of eye muscle. Akdag *et al.* [41] mentioned that ultrasound measurements (area and depth) at 12th and 13th ribs in live lambs were positively and significantly correlated with live weight (r= 0.88 and 0.91, respectively), cold carcass weight (r= 0.71 and 0.68, respectively) and carcass fat (r= 0.81 and 0.86, respectively). As well, significant and positive correlation were observed between ultrasound measurement of eye muscle width and live weight (r= 0.56), cold carcass weight (r= 0.62) and carcass muscle (r= 0.6). In this context, Gomes *et al.* [10] indicated that ultrasound muscle area on lambs showed a strong correlation with the amount of muscular tissue (r=0.66).

It is apparent from Table 7 that lean weight from the 13th rib was positively and significantly associated with ultrasound measurements of muscle depth, area and width of Damascus kids. However, the correlation coefficients of fat and bone weights separated from the 13th rib with ultrasound measurements were weak and not significant. It could be deduced that Damascus kids, which have higher ultrasound measurements of eye muscle, have higher lean content of their carcasses and lower fat and bone contents. Grill *et al*. [42] showed that the ultrasound muscle depth on Australian lambs was significantly lower than the carcass muscle depth. On the contrary, ultrasound-measured back fat thickness was found to be significantly thicker than carcass-measured back fat thickness. This result may be due to that the skin and fat layers, which were linked to the skin, were skinned from carcass. All tissue over the muscle involving the skin was regarded as fat during ultrasonic scanning.

It is clear that body measurements of male Damascus kids may be used to predict pre-slaughter weight, dressing percentage, hot carcass weight, weights of carcass cuts (Table 8) and carcass dimensions (Table 9). Body length (BL) was entered in all prediction equations to predict carcass cuts and measurements. Afterward, heart girth (HG) and chest width (CW) were the most variables used in prediction equations. These results are consistent with Abdel-Mageed and Ghanem [43] who found that body weight, body length and heart girth were highly significant ($P < 0.001$) accurately to predict eye muscle area in growing kids with $R^2 = 0.83$. Moreover, Abdel-Moneim [24] concluded that certain body measurements, such as body length (BL), heart girth (HG), height at withers (HW), chest width (CW), chest depth (CW), round circumference (RC), paunch girth (PG) and pelvis width (PW) could be used for predicting the live body weight, hot carcass and carcass cuts in Egyptian ram lambs. Shehata38 showed that BL and HG were the accurate variables used for predicting body weight, hot carcass weight, cold carcass weight and prime cuts weight of Barki lambs. Furthermore, Agamy *et al.* [5] indicated that BL, HG, HW, RC and PG represented good body measurements for predicting live body weight, hot carcass weight, leg weight, the total weight of trimmed meat and bones in carcasses of Ossimi, Rahmani and Barki ram lambs.in this regard, Costa *et al.* [39] mentioned that the best body measurements to find accurate prediction equation for living body weight, empty body weight, hot carcass weight and cold carcass weight were body length, withers height, breast width and thigh perimeter with R^2 = 0.80, 0.76, 0.80 and 0.80, respectively.

It is of interest that using ultrasound measurements (depth, area and width) between the 12th and 13th ribs on live Damascus kids led to accurate prediction for weights of hot carcass, leg, flank, shoulder, neck, best end of neck and middle neck in their carcasses (Table 10). Moreover, Table 11 reveals accurate prediction equations to predict real eye muscle width, depth and area using ultrasound measurements of width, depth and area of rib-eye muscle, respectively. Several studies indicated that ultrasound measurements between the 12th and 13th ribs showed a strong efficiency for predicting the carcass composition and cuts [44, 13, 14, 45, 15, 16, 46, 18, 47, 40, 48, 6, 19, 41, 49, 20, 9, 10]. lazăr *et al.* [11] used ultrasound measurements (subcutaneous fat, muscle depth, muscle perimeter and muscle area) with probe 7.5 MHZ between the 12th and 13th ribs to predict carcass cuts of Carpatina kids. The authors reported that high accuracy and strong coefficients of determination were obtained for estimation weights of carcass, leg, loin, rack, shoulder, flank and neck (R^2= 091, 0.91, 0.86, 0.90, 0.85, 0.94 and 0.84, respectively).

Conclusion

It is possible to predict the weight of carcass components and cuts and eye muscle measurements (area, depth and width) on live male Damascus kids using body measurements (i.e., body length, heart girth and chest width) and ultrasound measurements with probe 7.5 MHZ between the 12th and 13th thoracic vertebrae.

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Declaration of Conflict of Interest

We certify that there is no conflict of interest with any financial, personal, or other relationships with other people or organization related to the material discussed in the manuscript.

Ethical of approval

This study follows the ethics guidelines of the Cairo University's Institutional Animal Care and Use Committee (CU-IACUC) (ethics approval number; CU II F 32 22).

TABLE 1. Means (x̄) and standard errors (SE) for body weight and measurements of male Damascus kids aged 12 months as affected by presence of horns and type of birth

Factors	Presence of horns					Type of birth				
	Horned		Hornless			Single		Twins		
Traits	$\bar{X}$	SE	$\bar{X}$	SE	Sig.	$\bar{X}$	SE	$\bar{X}$	SE	Sig.
Animal weight (Kg)	31.7 a	1.17	22.0 b	2.43	**	32.6 a	2.13	27.4 b	1.35	NS
Body height at chest (cm)	67.9 **a**	0.74	63.0 **b**	1.54	*	68.8 **a**	1.35	65.5 **b**	0.85	NS
Chest depth (cm)	32.5 **a**	0.60	29.5 **b**	1.25	*	31.5 **a**	1.10	30.5 **a**	0.69	NS
Body height at pelvic (cm)	70.3 **a**	0.90	65.7 **b**	1.87	*	69.3 **a**	1.64	67.5 **a**	1.04	NS
Heart girth (cm)	72.1 **a**	1.00	64.0 **b**	2.08	**	72.6 **a**	1.83	68.8 **a**	1.16	NS
Paunch girth (cm)	75.0 **a**	1.51	69.7 **a**	3.15	NS	75.4 **a**	2.76	72.8 **a**	1.75	NS
Body length (cm)	68.8 **a**	0.61	61.7 **b**	1.26	**	69.4 **a**	1.11	65.8 **b**	0.69	NS
Neck length (cm)	31.3 **a**	0.80	28.7 **a**	1.66	NS	32.0 **a**	1.46	29.9 **a**	0.92	NS
Neck circumference (cm)	41.3 **a**	0.98	35.3 **b**	2.04	NS	43.0 **a**	1.79	38.0 **b**	1.13	NS
Round circumference (cm)	36.3 **a**	0.70	30.7 **b**	1.45	*	37.4 **a**	1.27	33.5 **b**	0.81	NS

Within each factor, means of each trait not followed by the same letter differ significantly from each other ($P < 0.05$). Sig.: Significance, * $P < 0.05$, ** $P < 0.01$, NS: not significant

TABLE 2. Means (x̄) and standard errors (SE) of carcass components and cuts of male Damascus kids as affected by presence of horns and type of birth

Factors	Presence of horns					Type of birth				
	Horned		Hornless			Single		Twins		
Traits	$\bar{X}$	SE	$\bar{X}$	SE	Sig.	$\bar{X}$	SE	$\bar{X}$	SE	Sig.
Head weight (Kg)	2.3 **a**	0.06	1.6 **b**	0.12	**	2.3 **a**	0.11	1.9 **b**	0.07	NS
skin weight (Kg)	2.1 **a**	0.11	1.4 **b**	0.24	NS	2.3 **a**	0.21	1.8 **b**	0.13	NS
feet weight (Kg)	0.88 **a**	0.03	0.70 **b**	0.06	*	0.89 **a**	0.05	0.81 **a**	0.03	NS
carcass with internal organs weight (Kg)	23.9 **a**	0.64	17.8 **b**	1.32	**	24.4 **a**	1.16	21.4 **b**	0.73	NS
heart weight (Kg)	0.14 **a**	0.005	0.09 **b**	0.01	*	0.14 **a**	0.0097	0.12 **b**	0.006	NS
lungs and trachea weight (Kg)	0.44 **a**	0.02	0.33 **b**	0.036	*	0.45 **a**	0.03	0.40 **a**	0.02	NS
liver weight (Kg)	0.505 **a**	0.02	0.35 **b**	0.04	*	0.53 **a**	0.04	0.43 **b**	0.02	NS
kidney weight (Kg)	0.10 **a**	0.004	0.07 **b**	0.009	*	0.10 **a**	0.008	0.08 **b**	0.005	NS
spleen weight (Kg)	0.044 **a**	0.0038	0.03 **a**	0.008	NS	0.05 **a**	0.007	0.024 **b**	0.004	NS
testis weight (Kg)	0.22 **a**	0.01	0.16 **b**	0.02	*	0.23 **a**	0.02	0.20 **a**	0.01	NS
full digestive tract weight (Kg)	5.6 **a**	0.26	4.4 **a**	0.53	*	5.3 **a**	0.47	5.3 **a**	0.30	NS
empty digestive tract weight (Kg)	2.39 **a**	0.07	1.89 **b**	0.14	*	2.45 **a**	0.12	2.16 **b**	0.08	NS
mesenteric fat wt. (Kg)	0.4 **a**	0.05	0.28 **a**	0.10	NS	0.4 **a**	0.09	0.35 **a**	0.06	NS
kidney fat weight (Kg)	0.2 **a**	0.03	0.19 **a**	0.07	NS	0.22 **a**	0.06	0.17 **a**	0.04	NS
heart fat weight (Kg)	0.04 **a**	0.008	0.03 **a**	0.02	NS	0.03 **a**	0.01	0.03 **a**	0.009	NS
hot carcass weight (Kg)	15.3 **a**	0.54	10.17 **b**	0.13	**	16.0 **a**	0.99	12.9 **b**	0.63	NS
left half hot carcass weight (Kg)	7.5 **a**	0.26	4.9 **b**	0.55	**	7.8 **a**	0.48	6.3 **b**	0.30	NS
right half hot carcass weight (Kg)	7.7 **a**	0.29	5.2 **b**	0.60	**	8.0 **a**	0.52	6.6 **b**	0.33	NS
left half cold carcass weight	7.3 **a**	0.24	4.8 **b**	0.49	**	7.6 **a**	0.43	6.2 **b**	0.27	NS
right half cold carcass weight (Kg)	7.6 **a**	0.27	5.2 **b**	0.57	**	7.9 **a**	0.50	6.5 **b**	0.31	NS
leg weight (Kg)	2.2**a**	0.07	1.5 **b**	0.14	**	2.3 **a**	0.12	1.9 **b**	0.08	NS
loin weight (Kg)	0.6 **a**	0.05	0.4 **a**	0.10	NS	0.66 **a**	0.09	0.49 **a**	0.06	NS
flank weight (Kg)	0.16 **a**	0.02	0.05 **b**	0.05	NS	0.18 **a**	0.04	0.11 **a**	0.03	NS
shoulder weight (Kg)	1.6 **a**	0.06	1.1 **b**	0.13	**	1.6 **a**	0.11	1.4 **b**	0.07	NS
Brisket weight (Kg)	0.58 **a**	0.04	0.35 **b**	0.08	**	0.57 **a**	0.07	0.50 **a**	0.04	NS
neck weight (Kg)	0.8 **a**	0.03	0.6 **b**	0.06	**	0.9 **a**	0.05	0.7 **b**	0.03	NS
best end of neck (6 rib-13) (Kg)	0.7 **a**	0.03	0.45 **b**	0.07	**	0.75 **a**	0.06	0.6 **b**	0.04	NS
middle neck (Kg)	0.5 **a**	0.03	0.27 **b**	0.07	*	0.6 **a**	0.06	0.4 **b**	0.04	NS

Within each factor, means of each trait not followed by the same letter differ significantly from each other ($P < 0.05$). Sig.: Significance, * $P < 0.05$, ** $P < 0.01$, NS: not significant

TABLE 3. Correlation coefficients between pre-slaughter body weight and measurements and carcass components and cuts of male Damascus kids

Carcass traits	Pre-slaughter weight	Body length	Body height at chest	Body height at pelvic	Heart girth	Chest depth	Chest width	Round circumference	Paunch girth	pelvis width
Dressing percentage	0.64*	0.70**	0.63*	0.79**	0.63*	0.67*	0.53	0.68*	0.06	0.48
Weight of:										
Head	0.96**	0.92**	0.63*	0.58*	0.77**	0.58*	0.87**	0.71**	0.37	0.75**
Skin	0.89**	0.81**	0.56*	0.44	0.57*	0.36	0.81**	0.55*	0.37	0.74**
Feet	0.89**	0.86**	0.55	0.64*	0.78**	0.68**	0.90**	0.59*	0.41	0.63*
Carcass with internal organs	0.99**	0.91**	0.67*	0.59*	0.80**	0.75**	0.94**	0.63*	0.57*	0.61*
Heart	0.91**	0.85**	0.72**	0.59*	0.73**	0.69**	0.80**	0.53	0.44	0.62*
Lungs and trachea	0.91**	0.85**	0.68**	0.53	0.79**	0.78**	0.87**	0.48	0.62*	0.46
Liver	0.93**	0.84**	0.65*	0.55	0.66*	0.55*	0.88**	0.60*	0.54	0.60*
Kidney	0.86**	0.89**	0.66*	0.56*	0.79**	0.54	0.76**	0.60*	0.31	0.71**
Spleen	0.60*	0.52	0.48	0.66**	0.43	0.28	0.52	0.53	0.19	0.61*
Testis	0.70*	0.61*	0.39	0.52	0.56*	0.3	0.64*	0.51	0.52	0.49
Full digestive tract	0.42	0.34	0.17	0.15	0.60*	0.18	0.42	0.41	0.67*	0.06
Empty digestive tract	0.91**	0.82**	0.61*	0.48	0.62*	0.49	0.84**	0.51	0.46	0.76**
Mesenteric fat	0.65*	0.55	0.25	-0.03	0.18	0.44	0.68**	-0.07	0.55*	0.35
Kidney fat	0.26	0.28	0.04	-0.19	0.01	0.33	0.35	-0.36	0.35	0.09
Heart fat	0.03	-0.04	0.06	-0.38	-0.38	0.13	0.09	-0.49	0.17	-0.19
Hot carcass	0.97**	0.92**	0.68**	0.68**	0.78**	0.70**	0.89**	0.71**	0.39	0.68**
Left half hot carcass	0.96**	0.91**	0.69**	0.70**	0.79**	0.71**	0.88**	0.73**	0.35	0.70**
Right half hot carcass	0.96**	0.90**	0.66*	0.63*	0.76**	0.70**	0.90**	0.70**	0.43	0.62*
Left half cold carcass	0.96**	0.92**	0.67**	0.70**	0.78**	0.69**	0.87**	0.74**	0.37	0.70**
Right half cold carcass	0.96**	0.89**	0.67**	0.62*	0.75**	0.70**	0.89**	0.69**	0.41	0.62*
Leg	0.93**	0.84**	0.64*	0.70**	0.76**	0.69**	0.86**	0.78**	0.41	0.61*
Loin	0.73**	0.79**	0.54	0.64*	0.69**	0.58*	0.68**	0.51	0.11	0.70**
Flank	0.87**	0.76**	0.46	0.38	0.46	0.38	0.82**	0.49	0.39	0.64*
Shoulder	0.93**	0.80**	0.60*	0.64*	0.68**	0.64*	0.87**	0.70**	0.43	0.56*
Brisket	0.69**	0.80**	0.36	0.3	0.75**	0.5	0.64*	0.52	0.19	0.54
Neck	0.93**	0.87**	0.71**	0.68**	0.71**	0.69**	0.84**	0.67*	0.31	0.68**
Best end of neck	0.96**	0.90**	0.65*	0.58*	0.71**	0.65*	0.88**	0.63*	0.47	0.67**
Middle neck	0.78**	0.72**	0.61*	0.62*	0.49	0.55	0.68**	0.58*	0.48	0.51

* $P < 0.05$, ** $P < 0.01$

TABLE 4. The correlation coefficients between monthly measurements (MM) of eye muscle (area, depth and width) using ultrasound on live Damascus kids and eye muscle measurements in their carcass (CM)

MM	CM								
	MA11	MA12	MA13	MW11	MW12	MW13	MD11	MD12	MD13
UA5	0.55	0.13	0.40						
UA6	0.44	0.44	0.69**						
UA7	0.66*	0.45	0.7**						
UA8	0.81**	0.59*	0.77**						
UA9	0.75**	0.50	0.67*						
UA10	0.79**	0.68*	0.84**						
UA11	0.71**	0.67*	0.74**						
UA12	0.78**	0.53	0.72**						
UW5				0.52	0.29	0.28			
UW6				0.40	0.38	0.32			
UW7				0.53	0.48	0.44			
UW8				0.46	0.51	0.68*			
UW9				0.61*	0.51	0.62*			
UW10				0.66*	0.58*	0.69**			
UW11				0.59*	0.63*	0.57*			
UW12				0.59*	0.57*	0.55*			
UD5							0.37	0.48	0.50
UD6							0.35	0.72**	0.74**
UD7							0.66*	0.75**	0.83**
UD8							0.60*	0.57*	0.71**
UD9							0.70**	0.56*	0.77**
UD10							0.72**	0.65*	0.84**
UD11							0.81**	0.62*	0.84**
UD12							0.86**	0.56*	0.78**

UA: muscle area by ultrasound, UW: muscle width by ultrasound, UD: muscle depth by ultrasound, MD11: muscle depth at 11th rib, MA11: muscle area at 11th rib, MW11: muscle width at 11th rib, MD12: muscle depth at 12th rib, MA12: muscle area at 12th rib, MW12: muscle width at12th rib, MD13: muscle depth at 13th rib, MA13: muscle area at 13th rib, MW13: muscle width at 13th rib. * P < 0.05, ** P < 0.01

TABLE 5. Correlation coefficients between pre-slaughter weight and eye muscle measurements by ultrasound on live Damascus kids and eye muscle measurements at the 11th ,12th and 13th ribs in carcass

Traits		Pre-slaughter weight	Eye muscle measurements on live kids by ultrasound		
			Muscle depth	Muscle area	Muscle width
Pre-slaughter weight		-	0.75**	0.79**	0.69**
11 rib	muscle depth	0.76**	0.66*		
	muscle area	0.77**		0.67*	
	muscle width	0.75**			0.39
12 rib	muscle depth	0.62*	0.63*		
	muscle area	0.62*		0.72**	
	muscle width	0.66*			0.57*
13 rib	muscle depth	0.78**	0.71**		
	muscle area	0.80**		0.78**	
	muscle width	0.79**			0.57*

* P < 0.05 ** P < 0.01

TABLE 6. Correlation coefficients between Eye muscle measurements on live kids by ultrasound and carcass traits and cuts of male Damascus kids

Traits	Eye muscle measurements on live kids by ultrasound		
	muscle depth	muscle area	muscle width
hot carcass weight	0.79**	0.79**	0.70**
left half hot carcass weight	0.78**	0.77**	0.67**
right half hot carcass weight	0.81**	0.81**	0.75**
left half cold carcass weight	0.77**	0.77**	0.66*
right half cold carcass weight	0.83**	0.81**	0.74**
leg weight	0.86**	0.87**	0.78**
loin weight	0.33	0.35	0.30
flank weight	0.69**	0.76**	0.64*
shoulder weight	0.84**	0.90**	0.81**
Brisket weight	0.43	0.29	0.31
neck weight	0.81**	0.79**	0.68**
best end of neck (6 rib-13)	0.77**	0.77**	0.64*
middle neck	0.70**	0.73**	0.52

* P < 0.05 ** P < 0.01

TABLE 7. Correlation coefficients between eye muscle measurements on live Damascus kids by ultrasound and weights of lean, fat and bone taken from the 13th rib of their Carcass

Eye muscle traits for the 13th rib	Eye muscle measurements on live kids by ultrasound		
	muscle depth	muscle area	muscle width
Lean weight	0.89**	0.65*	0.63*
Fat weight	0.26	0.20	0.19
Bone weight	0.05	-0.09	0.03

* P < 0.05, ** P < 0.01

TABLE 8. Prediction equations for calculating weights of body and carcass cuts (y) from body measurements (independent variables) of male Damascus kids

Prediction Equations	Sig.	R^2	S.E.
Pre-slaughter weight (PSW):			
PSW (Kg) = -23.38 + 0.24 BL (cm) + 0.25 BHC (cm) – 0.12 BHP (cm) – 0.04 HG (cm) – 0.16 CD (cm) + 1.32 CW (cm) + 0.16 RC (cm) + 0.18 PW (cm)	**	0.97	1.40
Dressing percentage			
DP (%) = - 3.18 - 0.33 PSW (KG) + 0.60 BL (cm) + 0.15 BHC (cm) – 0.96 HG (cm) + 1.18 CD (cm) + 1.09 RC (cm)	*	0.81	2.24
Hot carcass weight (HCW):			
HCW (Kg) = - 23.04 + 0.25 BL (cm) + 0.09 BHC (cm)+ 0.01 BHP (cm) - 0.29 HG (cm) + 0.27 CD (cm) + 0.45 CW (cm) + 0.33 RC (cm) + 0.20 PW (cm)	**	0.97	0.91
Leg weight (LEW):			
LEW (Kg) = - 1.99 + 0.02 BL (cm) + 0.003 BHC (cm) - 0.003 BHP (cm) -0.057 HG (cm) + 0.07 CD (cm) + 0.07 CW (cm) + 0.08 RC (cm) + 0.02 PW (cm)	**	0.96	0.87
Loin weight (LOW):			
LOW (Kg) = - 2.03 + 0.014 BL (cm) + 0.014 BHP (cm) + 0.005 CW (cm)+ 0.03 PW (cm)	*	0.73	0.11
Flank weight (FLW):			
FLW (Kg) = - 0.63 + 0.001 BL (cm) + 0.025 CW (cm) + 0.012 PW (cm)	**	0.73	0.05
Shoulder weight (SHW):			
SHW (Kg) = - 0.97 + 0.02 BL (cm) - 0.05 HG (cm) + 0.04 CD (cm) + 0.08 CW (cm) + 0.06 RC (cm)	**	0.90	0.12
Brisket weight (BRW):			
BRW (Kg) = - 1.53 + 0.02 BL (cm) + 0.012 HG (cm) - 0.014 CW (cm)	**	0.68	0.10
Neck weight (NEW):			
NEW (Kg)= -1.45 + 0.013 BL (cm) + 0.011 BHC (cm) + 0.015 BHP (cm) - 0.01 HG (cm) - 0.006 CD (cm) + 0.034 CW (cm)	**	0.89	0.07
Best end of neck (6^{th} - 13^{th} ribs) weight (BEON):			
BEON (Kg) = - 1.25 + 0.016 BL (cm) + 0.013 BHC (cm) - 0.007 HG (cm) - 0.011 CD (cm) + 0.035 CW (cm) + 0.003 PW (cm)	**	0.90	0.07
Middle neck weight (MNW):			
MNW (Kg) = -1.03 + 0.02 BL (cm) + 0.02 CW (cm)	*	0.53	0.12

BL: body length, HG: heart girth, CD: chest depth (cm), CW: chest width, BHC: body height at chest, BHP: body height at pelvic, RC: round circumference, PW: pelvis width, R^2: coefficient of determination, Sig.: significance, * $P < 0.05$, ** $P < 0.01$, S.E.: standard error.

TABLE 9. Prediction equations for calculating carcass measurements (y) from body measurements (independent variables) of male Damascus kids

Prediction Equation	Sig.	R^2	S.E.
carcass width at 3^{rd} rib			
CW3R (cm) = - 9.29 + 0.337 BL (cm) - 0.044 HG (cm) - 0.138 CD (cm) + 0.601 CW (cm)	*	0.75	1.78
carcass width at 7^{th} rib			
CW7R (cm)= - 3.322 + 0.003 BL (cm) + 0.121 BHC (cm) + 0.081 HG (cm) – 0.05 CD (cm) + 0.727 CW (cm)	**	0.86	1.07
Round length			
RL (cm) = 3.489 + 0.135 BL (cm) + 0.343 CW (cm) + 0.514 PW (cm)	*	0.58	2.07
Round circumference			
RCC (cm) = 5.928+ 0.096 BL (cm) + 0.204 BHC (cm) + 0.627 PW (cm)	**	0.71	1.53
carcass length			
CL (cm) = 66.218 - 0.352 BL (cm) + 2.937 CW (cm) + 0.954 PW (cm)	**	0.71	4.38

BL: body length, HG: heart girth, CD: chest depth (cm), CW: chest width, BHC: body height at chest, PW: pelvis width, R^2: coefficient of determination, Sig.: significance, * $P < 0.05$, ** $P < 0.01$, S.E.: standard error.

TABLE 10. Prediction equations for calculating carcass cuts weight (y) from ultrasound measurements (independent variables) of male Damascus kids.

Prediction Equation	Sig.	R^2	S.E.
Hot carcass weight (HCW):			
HCW (Kg) = 3.59 - 1.49 MWUS (cm) + 5.62 MDUS (cm) + 1.75 MAUS (cm^2)	**	0.67	1.87
Leg weight (LEW):			
LEW (Kg) = 0.63 - 0.18 MWUS (cm) + 0.71 MDUS (cm) + 0.24 MAUS (cm^2)	**	0.80	0.18
Flank weight (FLW):			
FLW (Kg) = - 0.03 - 0.07 MWUS (cm) + 0.027 MDUS (cm) + 0.087 MAUS (cm^2)	*	0.62	0.06
Shoulder weight (SHW):			
SHW (Kg) = 0.64 - 0.12 MWUS (cm) + 0.20 MDUS (cm) + 0.24 MAUS (cm^2)	**	0.82	0.14
Neck weight (NEW):			
NEW (Kg) = 0.19 + 0.35 MDUS (cm) + 0.10 MAUS (cm^2) – 0.11 MWUS (cm)	**	0.71	0.09
best end of neck (6 rib-13) weight (BEON):			
BEON (Kg) = 0.14 - 0.14 MWUS (cm) + 0.30 MDUS (cm) + 0.13 MAUS (cm^2)	**	0.68	0.10
Middle neck weight (MN):			
MN (Kg) = 0.13 + 0.21 MDUS (cm) + 0.23 MAUS (cm^2) – 0.28 MWUS (cm)	**	0.76	0.09

MAUS: ultrasound muscle area (cm2), MDUS: ultrasound muscle depth (cm), MWUS: ultrasound muscle width (cm), R^2: coefficient of determination, Sig.: significance, * P < 0.05, ** P < 0.01, S.E.: standard error.

TABLE 11. Prediction equations for calculating real eye muscle measurements (y) from ultrasound measurements of eye muscle (independent variables) of Damascus kids

Prediction Equation	Variables	Sig.	R^2	S.E.
REMW = 2.35 + 0.68 MWUS (cm)	MWUS	*	0.33	0.29
REMD = - 0.38 + 2.20 MDUS (cm)	MDUS	**	0.51	0.65
REMA = 0.37 + 2.97 MAUS (cm^2)	MAUS	**	0.61	0.72

MAUS: ultrasound muscle area (cm2), MDUS: ultrasound muscle depth (cm), MWUS: ultrasound muscle width (cm), REMA: real eye muscle area (cm2), REMD: real eye muscle depth (cm), REMW: real eye muscle width (cm), R2: coefficient of determination, Sig.: significance, * P < 0.05, ** P < 0.01, S.E.: standard error.

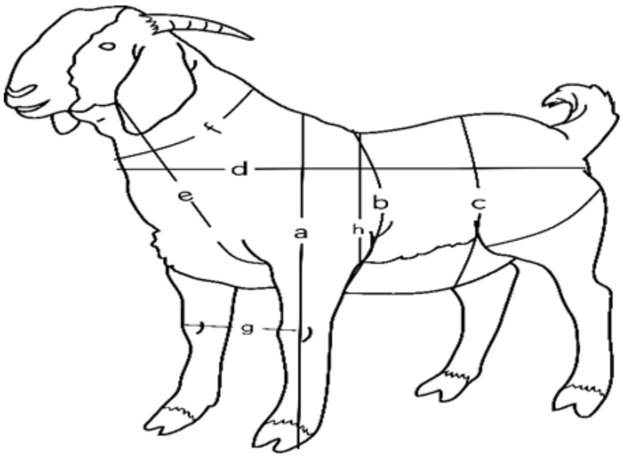

Fig. 1. (a) Body height at chest, (b) Heart girth, (c) Paunch girth, (d) Body length, (e) Neck length, (f) Neck circumference, (g) Chest width, (h) Chest depth, (i) Round circumference.

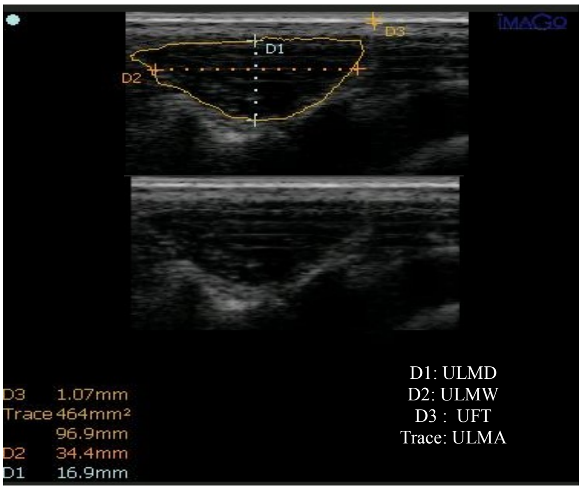

Fig. 2. Ultrasound measurements in real-time of fat thickness (UFT), depth of the Longissimus dorsi muscle (ULMD), and width of the Longissimus dorsi muscle (ULMW) between the 12th and 13th ribs.

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استخدام مقاييس الجسم والموجات فوق الصوتية لتقييم خصائص الذبيحة لذكور جداء الماعز الدمشقي

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الملخص

يمكن إستخدام مقاييس الجسم والموجات فوق الصوتية كعوامل حاسمة للتنبؤ بالذبيحة والتى يعتمد عليها تسويق الحيوانات الحية. تهدف الدراسة الحالية إلى تقييم مكونات الذبيحة وقطعياتها لجداء الماعز الدمشقي من الذكور وذلك من خلال مقاييس الجسم والموجات فوق الصوتية. بالإضافة إلى دراسة تأثير وجود القرون وحالة الميلاد (فردى أو توائم) على مقاييس الجسم وخصائص الذبيحة. تم استخدام ثلاثة عشر جدي من ذكور ماعز الدمشقي عمر 12 شهراً في الدراسة. تم أخذ قياسات الموجات فوق الصوتية (7.5 ميجاهيرتز) بين الفقرتين الصدريتين 12 و 13 على الجداء الحية.

كانت مقاييس الجسم ومكونات الذبيحة والقطعيات في الجداء المقرنة أعلى من تلك التي في الجداء عديمة القرون. لم يظهر لحالة الميلاد أي تأثير معنوي على وزن الجسم ومقايسه عند عمر 12 شهراً وكذلك على مكونات الذبيحة وقطعياتها. تم استخدام طول الجسم في جميع معادلات التنبؤ لقطعيات ومقاييس الذبيحة. وكان محيط الصدر وعرض الصدر من أكثر المتغيرات المستخدمة في معادلات التنبؤ. وجد ان استخدام مقاييس الموجات فوق الصوتية (العمق والمساحة والعرض) للعضلة العينيةعلى الجداء الحية ادت إلى التنبؤ الدقيق بأوزان الذبيحة الساخنة والفخذ والبطن والكتف والرقبة وقطعية نهاية الرقبة ووسط الرقبة في الذبائح. تم الحصول على معادلات تنبؤية دقيقة للتنبؤ بعرض العضلة العينية بعد الذبح وعمقها ومساحتها باستخدام قياس العضلة العينية قبل الذبح (العرض والعمق والمساحة على التوالي) بواسطة الموجات فوق الصوتية. حيث قدر معامل التحديد (R2) بـ 33% للتنبؤ بعرض العضلة العينية (إحتمال أقل من 0.05). علاوة على ذلك، ساهم تقدير عمق ومساحة العضلة العينية بواسطة الموجات فوق الصوتية بنسبة 51% و61%، على التوالي، من التباين الإجمالي في تقدير عمق ومساحة العضلة العينية الحقيقي (إحتمال أقل من 0.01).

الكلمات الدالة: ماعز الدمشقي ، مقياس الجسم ، قياسات الموجات فوق الصوتية ، معادلات التنبؤ ، مكونات الذبيحة وقطعيتها.