THE EFFECT OF LIVE BODY WEIGHT AT SLAUGHTER ON PERFORMANCE, CARCASS TRAITS AND BODY COMPOSITION OF AWASSI LAMBS

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ABSTRACT

To examine the effect of different slaughter weights on performance, carcass traits and body composition, twenty five weaned Awassi lambs (19.00 ± 0.12 kg) were divided equally and randomly into five groups. All groups were fed individually ad lib on concentrated diet contained 15.1 % crude protein and 12.2, MJ/kg metabolizable energy. Lambs were slaughtered at five different live weights (20, 25, 30, 35 and 40 kg). Results revealed that daily gain in weight increased from its lowest value (115.7 g) at 20 kg, to (338.8 g) at 30 kg and there after declined to (299.9 g) in lambs slaughtered at 49 kg. This was associated by a significant decline (P≤0.01) in feed conversion ratio. The daily dry mater intake was increased (P≤0.01) as the body weight increased. Dressing percentage, Rib eye area and back fat thickness increased (P≤0.01) with an increase of slaughter weight. While, the proportion of lean, bone and lean: fat ratio decreased (P≤0.01) from lighter to heavier weight. On the other hand, fat percentage and Lean: bone ratio increased (P≤0.01) as the slaughter weight increased.

Keywords: Daily gain, Feed efficiency, Dressing percentage, Carcass composition, Awassi

تأثير وزن الذبح في اداء و صفات الذبيحة و تركيب الجسم للحملان العواسية

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المستخلص

يهدف دراسة تأثير اوزان مختلفة عند الذبح في اداء و صفات الذبيحة و تركيب الجسم فقد تم توزيع 25 حمل عواسي مفطوم(19.00±0.2 كغم) عشوائيا الى خمسة مجاميع, وتم تغذية الحملان بصورة فردية و لحد الشبع على عليقة مركزة تحتوى على 15.1 % بروتين خام و 12.2 ميكا جول /كغم طاقة ايضية على ان تذبح بأوزان 20, 25, 30, 35 و 40 كغم. تشير النتائج بأن الزيادة الوزنية اليومية ازدادت من (115.7 غم)عند وزن 20 كغم الى (338.8 غم) عند وزن 30 كغم ومن ثم انخفضت عند وزن الذبح 40 كغم (299.9 غم). كما لوحظ انخفاض معنوى في كفائة تحويل غذائي و زيادة في كمية المتناول من المادة الجافة. ادى زيادة الوزن عند الذبح الى زيادة معنوية في نسبة التصافي و مساحة العظلة العينية و سمك الطبقة الدهنية. كما لوحظ حصول انخفاض معنوي في نسبة اللحم و العضم و نسبة الحم: الدهن و زيادة في نسبة الدهن و نسبة اللحم: العظم بتقدم الوزن عند الذبح.

الكلمات المفتاحية: الزيادة اليومية, كفائة تحويل غذائي, نسبة التصافي, تركيب الذبيحة, العواسي.

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INTRODUCTION

Sheep in Iraq are considered the most important farm animals, and the greatest proportion of income comes from the sale of lambs. Nevertheless their importance is further enhanced because they are the most suitable farm animals to the extensive area of arid and semi- arid of the country, as well as, the major sources of livelihood for the rural inhabitants of the area and will continue to maintain its importance in the futures due to increasing human population, and the increasing demand for meat production, particularly lamb and mutton (7). Evaluation of the carcass is essential to determine the relative production efficiency of the animals in converting feed to animal tissue (17). It is known also that lamb carcass traits and meat quality are affected by several factors including breed, sex, age, feeding system, slaughter weight and carcass weight (25, 31 and 33). Moreover, growth and development are the bases for meat production, and distributions of carcass tissues are significant in determining carcass quality. Lean muscle and to a lesser degree fat, are the major edible tissue of the carcass (20). Traditionally lambs meat is considered one of the most preferred types of meat by Iraqi consumer. Lambs are usually slaughtered between weaning (3- 4 months) and one year old. This procedure indicate that lambs are slaughtered under a wide range of body weight and fattening condition, 30 kg or less (light), 40 kg (average) and 50 kg or more (heavy). This situation usually controlled by demand rather than following an efficient system for producing meat from lambs (24). Since, there is a little information available on the composition of the fat-tailed Awassi sheep, and due to the consumers become more conscious, mainly being concerned with fat content and meat quality, it is important to provide more information about differences in carcass composition slaughtered at different live weights. Additionally, to find out at which live weight, lambs could be slaughtered to have a maximum lean content with acceptable fat. Therefore, this work was carried out to study growth, carcass traits and body composition of Awassi lambs slaughtered at different weight.

MATERIALS AND METHODS

The present experiment was conducted at animal farm, College of Agricultural Engineering Science, University of Duhok, where 25 weaned Awassi ram lambs (4 month) with an average live body weight of 19.00 ± 0.12 kg were used. Following an adaptation period for 10 days, the lambs were randomly and equally allocated and individually penned (1 ×2 m) into five treatment groups to be slaughtered at five different live weights (20, 25, 30, 35 and 40 kg). Lambs were fed concentrate diets ad-lib (Table 1). The offered concentrate was weighed daily, and the refusal was collected and weighed before morning feeding. Clean water was available constantly.

Table1. Ingredient and chemical composition of the diet.

Ingredient	%
Barley	53
Corn	17
Wheat bran	8
Wheat straw	3
Soybean meal	14
Urea	0.1
Oil	2.9
Salt	1
Mineral & Vitamin	0.5
Limestone	0.5
Total	100
Chemical composition[1]	
Dry matter	911.6
Organic matter	971.4
Ash	28.6
Crude protein	151.1
Ether Extract	42.3
Crude fiber	61.3
Nitrogen Free Extract [2]	627.5
Metabolizable Energy [3]	12.24

Chemical composition[1] (AOAC, 2007)
NFE[2]= 1000 - (water + Ash + CP + EE + CF).
ME[3] MJ/kg DM, (MAFF, 1975).
= [(CP*0.012) + (EE*0.031) + (CF*0,005) + (NFE*0.014)]

Slaughtering of animals

All lambs were slaughtered when each lamb has reached its target weight. Following fasting for 16 h lambs from each treatment were weighed and slaughtered according to (Halal) way at the College of Agricultural Engineering Sciences abattoir. The dressed carcass comprised the body after removing skin, head (at the occipito- atlantaljoint), fore feet (at the carpal- metatarsaljoint), hind feet

(at the tarsal metacarpalas joint) and the visceral. Hot carcass weight and weight of the head, skin, feet, and visceral organ, including heart, liver, lung with trachea, spleen and testes were recorded. Kidney and pelvic fat were retained in the carcass. The gastrointestinal tract, including the rumen, reticulum, omasum, abomasum and small and large intestine, were weighed then emptied of their content washed and re- weighed to facilitate calculation of empty body weight by subtracting the weight of cut content from the slaughter weight. Gastrointestinal content was calculated as the difference between full and empty gastrointestinal tract (GIT) weight. Omental, mesenteric, cardiac fat were separated and weighed.

Carcass measurements

After chilling the carcass at 4^{o} c for 24h, cold carcass was weighed and kidney and pelvic fat was weighed separately. The carcass was split along the vertebral column into two halves, using an electrical saw. The right half was separated into eight whole sale cuts. The cross-sectional area of L.dorsi muscle between 12 and 13 ribs was traced of the cutting and the area was subsequently measured by digital planimeter. Fat thickness over the midpoint of L. dorsi muscle was measured by using Caliper device.

Physical dissection

All whole cuts of the right half carcass were dissected completely into lean, fat and bone. The three components were weighed separately to determine their percentages. Non- carcass fat is the sum of the omental, mesenteric, pelvic, kidney and cardiac fat. Carcass fat including subcutaneous and intramuscular fat was separated from each cut and weighed.

Statistical analyses

The experiment was designed by complete randomized design CRD. Data was analyzed statistically using general linear model procedures within SAS (26). Duncan (14) multiple range test was used to test differences between treatments.

RESULTS AND DISCUSSION

Growth performance

Data related to growth performance including initial, final weight and daily gain in weight are illustrated in Table 2. In the present investigation, daily gain in weight averaged 275.43 ± 16.85g. The average daily gain recorded herein for Awassi lambs is higher than those recorded earlier for the same breed by Sherwany and Alkass (29), Yateem et al (35), Alkass and Kak (6) and Alkass and Hassan (5). Such finding could be attributed to variation in genetic makeup as well as environmental factors and feeding practices in particular. The average daily gain obtained in the current work for Awassi lambs increased from 115.7 g for lambs slaughtered at 20 kg to 338.8g in lambs slaughtered at 30 kg body weight and thereafter significantly declined ($p \leq 0.01$) to 299.9 g for lambs slaughtered at 40 kg. This increase in gain rate from 20 to 30 kg body weight may be is due to continues growth of tissue particularly muscle and bone (12). However, the decline in gain of lambs slaughtered at 40 kg body weight could be due mainly to the deposition of fat (27, 28, 13, 10 and 22) who found that daily live weight gain in lambs decreased with increasing slaughter weight. Feed consumption increased from 550 g to 934 g and is in the line with the findings of Jepsen and Greek (15) who noticed that dry matter intake was positively correlated with feeding period. In contrast feed efficiency decreased significantly ($p \leq 0.01$) with an increase in live weight up to 40 kg, possibly due to increased fat deposition. Similar results were reported by Semts (28), Balci and karakas (9) and Majdoub- mathlouthi (21).

Table 2. Effect of different slaughter weight on animal performance

Trait	Lambs slaughtered at				
	20 kg Body weight	25 kg Body weight	30 kg Body weight	35 kg Body weight	40 kg Body weight
Initial wt./ kg	18.54 ± 0.09	19.00 ± 0.18	19.38 ± 0.32	19.10 ± 0.43	19.00 ± 0.19
Final Wt./ kg	20.18^{e} ± 0.12	24.92^{d} ± 0.03	29.89^{c} ± 0.03	35.02^{b} ± 0.03	39.93^{a} ± 0.03
Total gain/ kg	1.64^{e} ± 0.07	5.92^{d} ± 0.16	10.51^{c} ± 0.31	15.92^{b} ± 0.43	20.93^{a} ± 0.20
Daily gain/ g	115.7^{c} ± 6.1	299.0^{b} ± 7.6	338.8^{a} ± 8.1	323.6^{a} ± 9.1	299.9^{b} ± 1.6
Total DMI/ kg	7.70^{e} ± 0.00	13.97^{d} ± 0.21	25.82^{c} ± 0.23	43.38^{b} ± 0.22	65.44^{a} ± 0.13
Daily DMI/ g	550.0^{e} ± 0.0	698.5^{d} ± 10.8	806.8^{c} ± 7.4	964.0^{a} ± 5.0	934.8^{b} ± 1.9
FCR kg/kg	4.73^{a} ± 0.20	2.36^{d} ± 0.05	2.46^{cd} ± 0.08	2.73^{c} ± 0.06	3.12^{b} ± 0.37

Values of $^{a, b, c}$ on the same row with different letters are significant different (P≤0.01)

Carcass traits

Carcass weight, empty body weight and dressing percentage as affected by slaughter weight are given in Table 3. The results indicate that lambs of heavier slaughter weights dressed higher (p≤0.01) than those of lighter weights. Such increase is might be attributed to differences in the degree of maturity of carcass and non-carcass components. Hence, carcass components particularly fats are late maturing and so their percentages increased as lambs slaughtered at a heavier weights, whereas the percentage of early maturing non-carcass components declined (18). Rib eye area increased from 7.58 to 12.6 cm^2 with an increase in slaughter weight from 20- 40 kg, and the differences among them were significant (p≤ 0.01), except those slaughtered at 30 and 35 kg body weight (p>0.05). Back fat thickness averaged 0.8, 0.9, 1.7, 1.7 and 2.5 mm, for lambs slaughtered at 20, 25, 30, 35 and 40 kg, respectively. Thus carcass back fat thickness was increased with an increase in slaughter weight. Such increase in back fat thickness is due to deposition of fat which are a late maturing tissue. The above-mentioned results are in the line with the findings of other investigators (1, 27 and 32).

Carcass composition

The composition of carcass tissue is demonstrated in Table (4). The percentages of lean, fat and bone are affected significantly (p≤ 0.01) by slaughter weight. The percentage of lean tissue remains almost constant from 20 to 30 kg body weight and thereafter decreased significantly (p≤0.05) up to 35 and 40 kg body weight. Also, bone percentage decreased (p≤0.05) gradually until reach to 40 kg, due to an early maturing pattern (3). Conversely, fat percentage increased significantly from 12.20 % to reach 21.68 % as slaughter weight increased from 20 to 40 kg. It is known that fat growth begins rather slowly, and then increased exponentially as the animal enters the fattening phase. Such decrease in lean percentage was due to the pattern of maturity rate and animal enters into the fattening phase (16). Lean: fat ratio decreased as slaughter weight increased and is expected due to decline in lean percentage and an increase in fat percentage. However, lean: bone ratio remains relatively constant with very little changes because both of them declined by increasing slaughter weight. These results are in agreement with those found earlier on same breed by Al-Sherwany and Alkass (29), Yateem et al (34 and 35) and other breed by Al-Saigh and Al-Jassim (4), Bicer (11), Negalski (23), Skapetas (30) and Aksoy and Ulutus (2).

Table 3. Effect of different slaughter weight on carcass trait.

Trait	Lambs slaughtered at				
	20 kg Body weight	25 kg Body weight	30 kg Body weight	35 kg Body weight	40 kg Body weight
Slaughter weight/ kg	$20.18^{e} \pm 0.12$	$24.92^{d} \pm 0.03$	$29.89^{c} \pm 0.03$	$35.02^{b} \pm 0.03$	$39.93^{a} \pm 0.03$
Hot carcass weight kg	$9.75^{e} \pm 0.14$	$11.19^{d} \pm 0.23$	$13.87^{c} \pm 0.29$	$17.54^{b} \pm 0.51$	$20.26^{a} \pm 0.09$
Empty body weight kg	$17.87^{e} \pm 0.19$	$21.35^{d} \pm 0.15$	$26.11^{c} \pm 0.22$	$30.89^{b} \pm 0.20$	$35.51^{a} \pm 0.17$
Shrinkage percentage	2.88 ± 0.25	3.27 ± 0.30	3.37 ± 0.41	2.83 ± 0.23	2.57 ± 0.21
Hot dressing % (Sla. wt.)	$48.35^{ab} \pm 0.82$	$44.92^{c} \pm 0.86$	$46.41^{bc} \pm 1.01$	$50.09^{a} \pm 1.45$	$50.74^{a} \pm 0.27$
Dressing % (EBW wt.)	$54.58^{ab} \pm 0.34$	$52.40^{b} \pm 0.76$	$53.12^{b} \pm 1.08$	$56.75^{a} \pm 1.32$	$57.04^{a} \pm 0.35$
Rib eye area cm^2	$7.58^{c} \pm 0.28$	$8.82^{bc} \pm 0.72$	$10.20^{b} \pm 0.40$	$10.40^{b} \pm 0.72$	$12.60^{a} \pm 0.26$
Fat thickness mm	$0.8^{c} \pm 0.0$	$0.9^{c} \pm 0.1$	$1.7^{b} \pm 0.1$	$1.7^{b} \pm 0.1$	$2.5^{a} \pm 0.1$

Values of $^{a, b, c}$ on the same row with different letters are significant different ($P \leq 0.01$)

Table 4. Effect of different slaughter weight on carcass composition

Trait %	Lambs slaughtered at				
	20 kg Body weight	25 kg Body weight	30 kg Body weight	35 kg Body weight	40 kg Body weight
Lean **	$62.94^{a} \pm 0.93$	$63.33^{a} \pm 0.61$	$62.63^{a} \pm 0.78$	$58.19^{b} \pm 0.87$	$57.36^{b} \pm 2.09$
Fat **	$12.20^{c} \pm 1.26$	$11.93^{c} \pm 0.94$	$15.46^{bc} \pm 1.02$	$17.91^{b} \pm 0.53$	$21.68^{a} \pm 1.78$
Bone **	$24.85^{a} \pm 0.52$	$24.72^{a} \pm 0.59$	$21.90^{bc} \pm 0.70$	$23.88^{bc} \pm 0.88$	$20.94^{c} \pm 0.68$
Lean : fat ratio **	$5.41^{a} \pm 0.63$	$5.45^{a} \pm 0.46$	$4.12^{b} \pm 0.30$	$3.26^{bc} \pm 0.12$	$2.74^{c} \pm 0.31$
Lean : bone ratio *	$2.53^{ab} \pm 0.04$	$2.56^{ab} \pm 0.61$	$2.87^{a} \pm 0.09$	$2.45^{b} \pm 0.11$	$2.75^{ab} \pm 0.18$

Values of $^{a, b, c}$ on the same row with different letters are significant different * ($P \leq 0.05$) ** ($P \leq 0.01$)

Carcass and non-carcass fat

Weight of the total body fat, carcass and non-carcass fat and fat tail averaged 3.46, 1.00, 0.70 and 1.76 kg, respectively. Moreover, the percent contribution of carcass fat, non-carcass fat and fat tail to the total body fat were 28.40, 21.74 and 49.84 % respectively (Table 5). It appears from table that Awassi lambs slaughtered at 40 kg body weight had significantly ($p \leq 0.01$) higher amount (5.43 kg) of deposited fat than groups slaughtered at 35 (4.68 kg), 30 (3.23 kg), 25 (2.28 kg) and 20 (1.69 kg) kg body weight. These results are in agreement with those found earlier in total body fat by Skapetas (30), fat tail weight by Majdoub-Mathlouthi (21) and Abdullah and Qudsieh (1) and carcass fat by Sefdeen and Alkass (27), Al-Saigh and Al-Jassim (4), Negalski (23) and Aksoy and Ulutus (2) who concluded that fat deposited increase by increasing slaughter weight.

Table 5. Effect of different slaughter weight on carcass and non- carcass fat

Trait	Over all mean	Lambs slaughtered at 20 kg Body weight	25 kg Body weight	30 kg Body weight	35 kg Body weight	40 kg Body weight
Wt. carcass fat/ kg	1.00 ± 0.10	0.51^{d} ± 0.05	0.55^{d} ± 0.04	0.87^{c} ± 0.05	1.27^{b} ± 0.06	1.79^{a} ± 0.11
Wt. non- car. fat/kg	0.70 ± 0.03	0.46^{e} ± 0.01	0.54^{d} ± 0.00	0.67^{c} ± 0.01	0.86^{b} ± 0.00	0.95^{a} ± 0.02
Wt. fat tail/ kg	1,76 ± 0.01	0.71^{d} ± 0.02	1.18^{c} ± 0.07	1.68^{b} ± 0.08	2.54^{a} ± 0.01	2.68^{a} ± 0.02
Total body fat/ kg	3.46 ± 0.30	1.69^{d} ± 0.07	2.28^{d} ± 0.07	3.23^{c} ± 0.07	4.68^{b} ± 0.22	5.43^{a} ± 0.39
Non- carcass fat %	21.74 ± 0.83	27.58^{a} ± 1.32	23.94^{b} ± 1.07	20.81^{c} ± 0.60	18.54^{c} ± 0.9	17.84^{c} ± 0.73
Carcass fat %	28.40 ± 0.88	30.21^{ab} ± 2.11	24.38^{c} ± 1.85	27.04^{bc} ± 1.69	27.34^{bc} ± 0.76	33.03^{a} ± 0.79
Fat tail %	49.84 ± 1.09	42.19^{b} ± 1.51	51.66^{a} ± 2.17	52.13^{a} ± 2.09	54.10^{a} ± 1.32	49.11^{a} ± 1.30

Values of $^{a, b, c}$ on the same row with different letters are significant different (P≤0.01)

CONCLUSION

It could be conclude that, an increase in slaughter weight was associated with a decrease in daily gain and feed conversion ratio, and an increase dressing percentage, fat percentage and some whole sale cuts. Therefor in view of results it could be suggested to slaughter Awassi lambs at 30 or 35 kg live body weight considering the carcass traits and the economic point of view.

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