EFFECTS OF SLAUGHTER' AGE ON GROWTH PERFORMANCE, CARCASS AND NON-CARCASS COMPONENTS TRAITS OF BERBER BREED LAMBS

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ABSTRACT

The objective of this work was to study the lamb's growth, the carcass yield and composition and the importance of main organs of Berber lambs slaughtered at 4 or 6 months. The study concerned 40 lambs reared under motherhood. Lambs of the first group were slaughtered at the age of 4 months (4M) and the second at 6 months (6M). Slaughter body weights (BW), hot and cold carcass weights and organs were recorded. The carcass was cut out and dissected. The average BW at birth was 4.14 ± 0.506 kg while the BW at slaughter was 22.86 kg ± 3.40 and 31.51 ± 3.50 kg for 4M and 6M groups, respectively. The average daily gain were 172 and 164g for 4M and 6M groups, respectively. Therefore, during 2months the lambs of 6M group gained 8.67 kg in BW. The carcasses were heavier for 6M than 4M. The carcass commercial yields were 42% and 45% for 4M and 6M groups, respectively, resulting in 4.1 kg gain of meat during 2 months. The tissular (muscle, fat and bone) and the regional (leg, shoulder …) carcass composition did not differ among groups. All organs were heavier for 6M than 4M; however, their proportion in the empty body weight were variables. The BWand carcass gain at six months are encouraging to prolong the lamb's slaughter age without carcass composition difference given the similar fat proportion in the carcass of both groups.

Key words: Sheep, body weight gain, carcass, non-carcass components

تاثير عمر الذبح على النمو و صفات الذبيحة و مكوناتها عند خرفان سلاتة البربر

سعاد عترون1 الشذلي عيساوي1 سمير سماتي 2 نزيهة عاتي2
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المستخلص

يهدف هذا العمل لدراسة النمو وخصوصيات الذبيحة وأهمية الأعضاء الرئيسية للخرفان من سلالة البربر حسب العمر عند الذبح. شملت الدراسة 40 حملًا تمت تربيتها في نفس الظروف مع أمهاتها. تم ذبح المجموعة الأولى بعمر 4 أشهر (4ش) والثانية بعمر 6 أشهر (6ش). تم تسجيل الوزن قبل الذبح وبعد التبريد وكذلك الذبيحة الساخنة والباردة والأعضاء الخارجية والأحشاء. تم تقسيم الذبيحة إلى أجزاء وتشريح الجزء الأمامي (الساق). كان وزن الخرفان على التوالي عند الولادة وفي 4ش و6ش 4،14، 22،86 و31،51 كغ، بذلك اكتسبت الحملان من مجموعة 6ش 8.67 كجم في وزن الجسم خلال شهرين. كان متوسط الكسب اليومي 172 و164 غ لمجموعات 4 ش و6 ش على التوالي. كان وزن الذبائح أرفع عند 6 ش من 4 ش، أما نسبة التصافي فكانت 42٪ و45٪ للمجموعتين 4 ش و6 ش على التوالي، مما أدى إلى زيادة 4.1 كجم من اللحوم خلال شهرين. لم تختلف تركيبة الذبيحة النسيجية (العضلات والدهون، والعظام) ولا نسبة الأجزاء في الذبيحة (الساق، الكتف …) بين المجموعات. كانت جميع الأعضاء أثقل عند خرفان 6ش من ش. ومع ذلك، كانت نسبتهم في وزن الجسم الفارغ متغيرة. إن ارتفاع وزن الجسم والذبيحة عند ستة أشهر يشجع على التمديد عمر ذبح الحملان بدون التأثير في تكوين الذبيحة نظرًا لنسبة الدهون المماثلة في الذبيحة لكلتا المجموعتين

الكلمات المفتاحية: الأغنام , وزن الجسم، الذبيحة، ألاحشاء

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INTRODUCTION

In Algeria, sheep farming occupies a very important place in the animal productions, and the national economy. It is one of the most traditional agricultural activities because of its management, which is subject to climatic, nutritional and pathology. The local sheep has always evolved in a nomadic system under an arid to semi-arid climate, which is characterized by periods of drought between and within years. Although it is the country's main supplier of red meat, sheep farming has a low productivity due mainly to an extensive system whose non-rational management and feeding are the main limiting factors (8). The Algerian sheep population is composed of several local breeds with heterogeneous morphological characteristics that are well adapted to their environment and are distributed throughout the country with a remarkable attention in the steppe of the northern part of Algeria. Numerous experiments have been conducted on some local Algerian sheep breeds, such as OuledDjellal and the Hamra (1-6). However, few referenced studies have focused on the Berber breed, traditionally reared in the Atlas Mountains from east to west.Moreover, and for Algerian sheep breeds in general, there are only few studies on carcass' characteristics and meat quality. The scarcity of the studies on Berber breed motivated us to carry out this experiment on the lamb's growth performance and carcass traits when reared in its natural pastures traditional breeding system. On the other hand, and knowing that the increasing of slaughter body weight (BW) resulted in augmentation of BW but also carcass adiposity (23-26), we aim to study the carcass characteristics when lambs were slaughtered at traditional age of 4 months and increasing this age to 6 months.

MATERIALS AND METHODS

Animals: The study was conducted on 40 lambs born in open lambing of the Berber breed in a traditional farm in the mountains of northeastern Algeria on natural pastures. For the study of growth, animals were weeklyweighted before feeding, using a high precision electronic scale; thebody weight (BW) was recorded from birth until slaughter, which took place at four months for group 4M and at six months for group 6M. Weighing was carried out in the morning on an empty stomach. The average daily gain (ADG) was calculated as the difference between BW_i and BW_{i-1} divided by number of days.

Measurements during slaughter

Before slaughter, lamb body weights (SBW) were recorded. After slaughter, all organs were removed and individually weighted. First the external organs, head, legs and skin were separated followed by the digestive tract where omental and mesenteric fat (OMF) were removed. All fractions of the digestive tract (reticulo-rumen + omasum (rumen), abomasum, and intestine) were weighed full then empty after hand rinsing, in order to determine the weight of the digestive contents (DC) by difference. The thoracic organs such heart, lungs + trachea and viscera such spleen, liver and kidney were weighed.The carcasses were immediately weighed (hot carcass weight, HCW) and then stored in a cold room for 24 hours at +4° C.

Carcass cutting and dissection

The cold carcass weight (CCW) was recorded 24 h post-mortem after storage at 4°C. After separation of the tail, each carcass was split longitudinally in two parts. The left half, after removal of the kidney fat, was cut into six joints (shoulder, leg, collar, breast, covered rack and uncovered rack, Figure 1) according to the model of Colomer et al (12). Each joint was immediately weighed. For the study of carcass tissular composition, the leg of each carcass was dissected into muscle, fat and bone tissue for estimation of carcass composition (10).

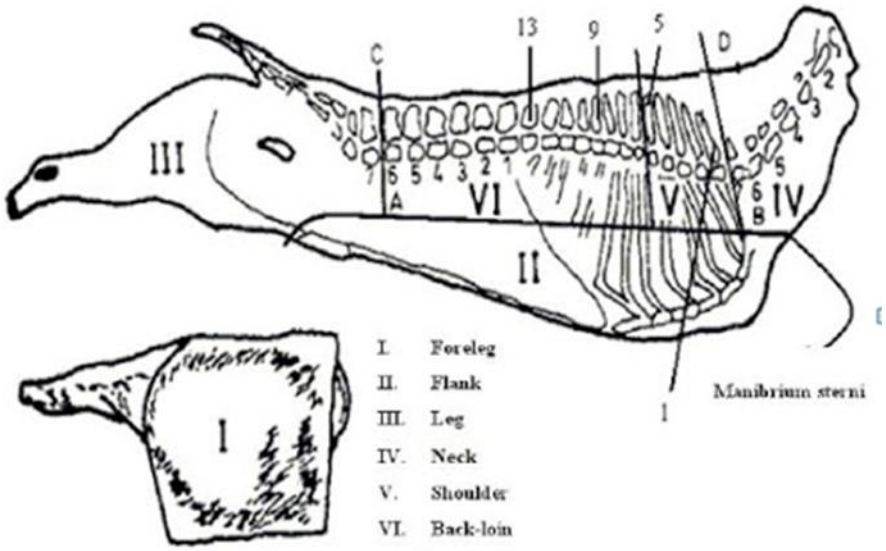

Figure 1. Cutting of the half-carcass according to the colomer-rochet model (12) i: shoulder, ii: flank, iii: leg, iv: neck, v: loin, vi: ribs, vii: tail

Calculation and statistical analysis

The EBW was calculated as the difference between BW before slaughter and weight of digestive contents. Commercial and real dressing percentages (CDP, RDP) were calculated according to the following equations:

CDP (%) = 100 * WCW / BW===RDP (%) = 100 * CCW / EBW

Statistical analysis was performed by analysis of variance using the GLM procedure of SAS. The effects of slaughter age on offal component weights, tissues weights and their proportions in EBW or in carcass, were analysed according to the following model:

$Y_{ij} = \mu + A_i + e_{ij}$

(Y_{ij} = jth measure of the ith diet; μ = overall mean; D_i = effect of the $i$thage (4M, 6M); e_{ij} = error term); significance was declared at $P<0.05$.

RESULTS AND DISCUSSION

Growth performances

The data in Table 1 indicates that the average birth weight of the lambs was 4.136 ± 0.506 kg; this weight varied between 3.4 kg and 5 kg. The result confirms what has been recorded in OuledDjellal lambs reared under similar rearing conditions to the current study (13) or reared on stubble (21). However, the lambs in the current study are lighter at birth compared to those reported by Djellal et al (14) weighing on average 5 ± 0.4 kg at birth in spring and 6.4 ± 0.4 kg in autumn.The birth weight of lambs is affected by the nutrition of the mother during the last third of pregnancy. During this phase, nutritional status affects particularly, the size and vigor of the lamb at birth (3, 13). For this in the study of Djellal et al. (14), lambs born in autumn, a period more favorable had better growth.The growth evolution from birth to slaughter was reported by Figure II. The Weaning weight, which occurs in traditional extensive rearing between 4 and 5 months of age, is highly dependent on the lactation level of the mother, the quality of the milk produced and the rearing method. This correlation has been observed while conducting the current study on lambs, which, due to the autumn birth season, show a higher average of daily gains during the first four months, compared to the 4-6 months period (Table 1). The lambs that are still underweight show satisfactory growth to match that of lambs from fast growing breeds. The weight gain of lambs during the first 16 weeks is approximately 19 kg (±1.36 kg). The measured weight gain is slightly higher than that observed by Dekhili (13) in OuledDjellalbreed lambs. During the first 16 weeks, corresponding to the slaughter age of Group 4 M, ADG were around 175 g. In contrast, in Group 6M where the lambs were slaughtered eight weeks later, with an average weight of 30.51 kg, there was a decline in growth rate resulting in lower average ADG (126g). This result is in line with that reported by Djellal et al. (14) where ADG between 1 and10 days was higher (213 g) than that between 30 and

90 days (144 g). During the second phase of growth, the ADG is significantly lower compared to the first phase of age. This result is the consequence of lamb's nutritional statue.The lactation level of dams, after a peak, stars decreasing which affects the lamb's growth given their strongly correlation. In addition, the transition from milk, to diet grasswhich can not allow a satisfactory coverage of maintenance needs and growth without any concentrate supply.

Table 1. Birth and slaughter weights, body weight gain (bwg) and average daily gain (adg) measured on lambs slaughtered at 4 months (4m) and 6 months (6m) of age.

Variables	Mean	Standard deviation	Minimum	Maximum
Birthweight (kg)	**4.136**	**0.506**	**3.40**	**5.00**
BW at 4months (kg)	**22.87**	**3.4**	**18.40**	**28.30**
BW at 6 months (kg)	**30.51**	**3.50**	**24.50**	**33.90**
ADG 0-4 months (g)	**175**	**32.18**	**135**	**223**
ADG 4-6 months (g)	**126**	**34.3**	**96.4**	**194.6**

However, it is worth to note the the important whole BW gain between 4 and 6 months (>7.5kg) in two months. This is an interesting result encouraging practicing lamb's fattening in pasture or feedlot in the aim to increase lamb meat production. The feedlot lamb's fattening (2/3 concentrate, 1/3 hay) resulted in higher ADG for Tunisian sheep breed, 190 and 160 g for Queue Fine de l'Ouest (QFO) and Noire de Thibar breeds (17), which have similar adult BW as Berber breed. In contrast, the ADGrecorded in the current study was higher than QFO lamb's ADG fattened with ration composed by 50 % hay and 50 % concentrate (4). It is so higher than thatrecordedforDjallonké lambs in Senegal,60 g from birth to 1 year of age (15). It should be noted that regardless of the performance-monitoring period, growth levels are characterized by significant individual variation, probably as a result of better availability of mother's milk and variable feed intake between lambs as well as difference in genetic potential.

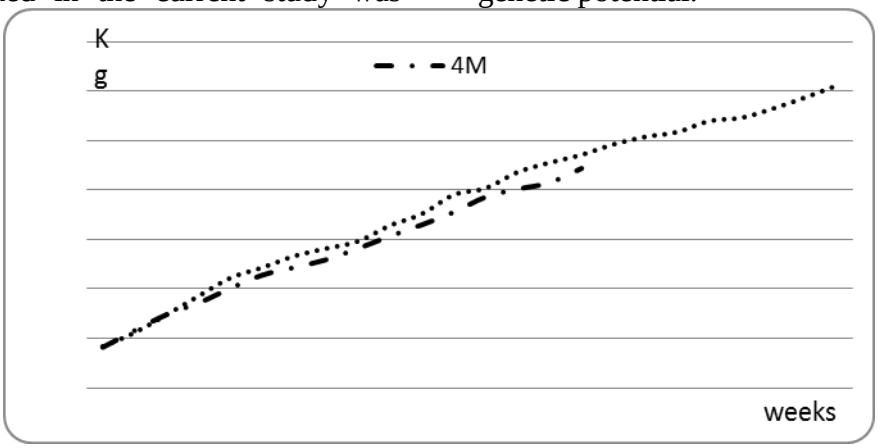

Figure 2. Evolution of the weekly average live weight of lambs in group 4m (-.- .-) and group 6m (...)=

Carcass traits

Carcass weight is considered as the primary factor, which determines the carcass quality and classification. The hot and cold carcass weights are shown in Table 2 with significant differences between groups (4 to 5 kg). During the 24-hour drying period, the weight loss was 86g and 400g respectively in group 4M and group 6M. The significant difference between the groups would be correlated with the weight at slaughter of the animals. According to Barone et al (7), the greater the weight at slaughter, the greater the loss during re-drying. The 400g re-drying loss for group 6M is lower than the 2% reported in the literature. The carcass yielding expressed by DP is shown in Table 2. Commercial DP was 42% and 45% for 4M and 6M groups, respectively (Table 2) without significant difference between groups.The true yields, was 51% and 54% respectively for groups 4M and 6M. This proportion would be high, taking into account the standard 0.27% increase in carcass yield for each additional kilo of live weight (18-22). In addition, as explained by Geay (16) in the normal growing lamb, yield increases

progressively because of higher rates of muscle and fat growth than cavity development, with most of the musculature remaining in the carcass. The recorded carcass yields resulted from fasted lambs; so they were not influenced by the weight of the digestive tract, which is thought to be one of the most essential causes of variation in carcass yield (18) where the percentage of digestive tract filling varies between 10 and 22% of body weight before fasting (22).

Table 2.Slaughter body weight (sbw), hot and cold carcass weights and dressing percentages (dp) of lambs slaughtered at 4 months (group 4m) and 6 months (group 6m) of age

	4M	6M	p-value
SBW (kg)	**22.18 ± 3.58**	**30.79 ± 3.46**	**0.009**
Emptybodyweight (kg)	**18.38 ±3.15**	**25.89 ± 3.06**	**0.009**
Hot carcassweight (kg)	**9.41 ±0.72**	**14.03 ± 0.64**	**0.010**
Cold carcassweight (kg)	**9.01 ±1.84**	**13.17 ± 1.52**	**0.010**
Commercial DP (%)	**42±3.74**	**45 ±1.81**	**0.118**
TrueDP (%)	**51 ±4.46**	**54±2.67**	**0.720**

Carcass composition

The regional carcass composition is traduced by the importance of joints at cutting. All joints showed a significant increase in weight with age (Table 3). This increase is related to carcass weight (3, 20). However, the proportions of each joint in the carcass are similar in both groups regardless of age at slaughter (25, 18.5, 24, 12.5, 9 and 9 for leg, shoulder, ribs, loin, neck and flank, respectively).This consistency in the proportion of the different cuts confirms the theory of anatomical harmony demonstrated by Boccard and Dumont (9) and reported by other authors on other breeds (3-26,25).The tissular carcass composition is traduced by the importance of tissues (muscle, fat, bone) at dissection of whole carcass or representative joint. The Table 4reported the weight and proportion of the different tissues from the leg dissection. The weights of alltissueswere significantly higher in lambs of 6M than those of 4M group. The first gained 350g more muscle, 41g more fat and 46g. This increase of the carcass tissue resulted from increase of carcass, which weight is strongly correlated to tissue's weight (17, 20). According to Boccard et al (10), the percentage of muscle is also higher in the leg and the hind limb that appears to be proportionally the least fat laden area. Indeed, muscle's proportion was similar for both groups given this tissue had an intermediate development. However, the proportion of adipose tissue(fat) was higher for 6M than 4M while that of bone had an inverse evolution (Table 4).This tendency traduced the tardive development of adipose tissue vs. the precocity of bone tissue (26, 10, 17).Our values are similar to those reported by the last authors.

Table 3. Weight and proportions of different carcass' joints of cutting of lambs slaughtered at 4 months (4m) and 6 months (6m) of age

		group 4M	group 6M	p-value
Shoulder	**(g)**	**984 ± 207**	**1336 ± 138**	**0.028**
	%	**22 ± 1.15**	**21 ± 0.75**	**0.149**
Leg	**(g)**	**1132 ± 225**	**1603 ± 190**	**0.017**
	%	**25 ± 1.00**	**24 ± 1.07**	**0.766**
Ribs	**(g)**	**1013 ± 72**	**1600 ± 193**	**0.001**
	%	**23 ± 1.89**	**25 ± 1.50**	**0.112**
loin	**(g)**	**543 ± 17**	**848 ± 99**	**0.002**
	%	**12 ± 1.27**	**13 ± 0.95**	**0.139**
Neck	**(g)**	**391 ± 131**	**588 ± 140**	**0.044**
	%	**9 ± 1.58**	**9 ± 0.33**	**0.213**
Flank	**(g)**	**435 ± 81**	**483 ± 52**	**0.364**
	%	**10 ± 2.22**	**8 ± 0.34**	**0.120**

Table 4: Weight in grams of different tissues and their proportions (percentage) in the leg of lambs slaughtered at 4 months (4m) and 6 months (6m) of age

	group 1	group 2	p-value
Muscle (g)	803±216	1153±148	0.016
(%)	71 ±4.13	72±2.29	0.749
Fat (g)	46±19	91±31	0.037
(%)	4.2±1.88	5.7±2.01	0.226
Bone (g)	263±40	349±64	0.033
(%)	23.9±2.61	21.7 ±2.61	0.151
Waste (g)	7.9±3.85	12.1±8.59	0.192
(%)	0.07±0.04	0.07± 0.05	0.926

The importance of non-carcass components

The weights and proportions of the organs are shown in Table 5. Except the Digestive tract and omental fat, the weights of all other organs (external and internal) were significantly affected by slaughter' age and were higher for 6M than 4M group. This increase in the weight of non-carcass components is related to the increase of EBW and carcass weights (19-24). However, the organ's proportion of EBW is variable; this is related to the earliness of the organ's development. The feet, which consist almost entirely of bone, an early tissue, have seen their proportion decrease while the proportion of skin, withhigher metabolic activity, has increased significantly (10,5). Beyond body development, the slaughter of unshorn lambs would be an additional factor in this difference in skin weight. Mesenteric fat, which is earlier, has kept the same proportion while the proportion of omental fat, which is later in relation to rumen development, has increased (2). Similarly, kidney and liver weights increased without an increase in their proportion. However, testicles showed a highly significant increase in weight, and even more in the proportion in EBW,forolder lambs (6M) compared to young ones (4M), again in relation to the precocity of the organs (24). The testicles are of late development in relation to the development of the reproductive function; their proportion of 1.2 for 4M has quadrupledto reach 6 % in the 6M group; the lambs being in the late developmental phase before puberty, which confirmed the results of Boussenaet al, (11) who found a positive correlation between testicles growth and their weights, body weight and age.

Table 5. Organ weights and their proportions in the empty live weight (elw) of lambs slaughtered at 4 months (4m) and 6 months (6m) of age

Organes	W kg			% ELW		
	4M	6M	P value	4M	6M	P value
Skin	1.63 ±0.21	2.66±0.43	0.003	8.94 ±0.64	10.26 ±0.76	0.011
Head	1.36 ±0.19	1.86 ±0.24	0.009	7.43±0.33	7.20±0.74	0.560
Feet	0.73 ±0.10	0.87 ±0.09	0.064	4.02±0. 24	3.37±0.21	0.002
Liver	0.40 ±0.07	0.63±0.10	0.008	2.21±0.24	2.45±0.32	0.145
Digestive tract	2.44±0.40	2.89 ±0.53	0.153	13.34 ±1.43	11.21±1.62)	0.029
Mesenteric fat	0.17 ±0.06	0.26 ±0.11	0.046	0.93±0.23	0.99±0.3	0.423
Omental fat	0.29 ±0.11	0.49 ±0.33	0.211	1.56±0.47	1.98 ±1.46	0.547
Kidney	0.13±0.03	0.21±0.	0.008	0.73±0.07	0.82±0.11	0.050
Testicles	0.02± 0.43	0.17± 0.03	0.001	1.21± 0.28	6.22± 0.29	0.010

CONCLUSION

The present study shows that the growth performance achieved by Berber lambs is appreciable; it is worth noting the BW gain between 4 and 6 months.However, the higher ADG during the first phase (group 4M) compared to the second (6M) highlights the importance of milk feeding. Hence a concentrate supply for lambs became necessary from 3-4 months old to improve or at least conserve the growth potential shown in the first phase. The Carcass weight and yields were rather higher for lambs over four months of age resulting in a gain of meat production as well as comestible organs. In addition, the adiposity of carcass was similar for both ages, which encouraging to prolong the lamb's age and thereby the BW at slaughter. The growth potential of the Berber breed is interesting and could be ameliorated by balanced diet at each growth phase.

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